Mechanical World

AND ENGINEERING RECORD

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FEATURES:
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Also angular misalignment.

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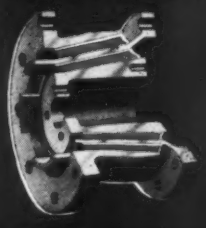


METALASTIK

Mechanical World —— October 1959

Art in Formulae

ALMOST a year ago we commented on the step taken by the Council of Industrial Design to interest what is called "heavy" industry in the principles it is seeking to promulgate. We have just been reading the Council's recently issued annual report: it mentions the occasion referred to above and also the request of textile machinery manufacturers to have a similar function organized for their instruction. Apart from this there is no evidence in the report of any practical outcome, no picture of a redesigned engineering product, though there are plenty of pictures of very attractive consumer goods—and this despite the fact that in past reports there have been pictures of machinery, which, we must say, looked familiar to us, so much so that we have sometimes wondered whether industrial designers, as they are at present, do not find much to improve upon in typical products of engineering ingenuity.

It is, of course, true that what the engineer or industrialist buys is not for the public gaze. It does concern him and his workpeople however, and they judge a thing by what is to them its beauty—a quality compounded of a number of factors which include what it does and how it does it as well as how little incidental and accidental trouble it causes: and a further factor, not so definable, which concerns how it was made—and that may mean the inside and not the outward appearance.

The Council is certainly having a great influence on the appearance of a great many everyday things, and that means that large numbers of people are becoming aware instinctively of what is good design. Undoubtedly this must be affecting the work of many other people who are concerned in the form and purpose of new products. Perhaps it is sufficient to sow a seed in the most prolific quarter for it to spread its influence in a great many directions, and perhaps engineering designers have been influenced in this way—in fact we feel pretty sure that this really is happening. At some stage, however, this particular element in the design process must become more ordered and be applied consciously and objectively. An engineering interpretation has not yet appeared. We design for maximum economy, or for minimum deflexion or to some other end, but there is as yet no optimum appearance factor embodied in the calculations. Is it too much to expect that the dynamic system of art should have a place in calculations which, whatever else they do, certainly have the effect of determining outward form?

LOG SHEET

Metallurgical Control

At the headquarters of the Holman Group in Camborne, Cornwall, a new metallurgical control and heat treatment department has been built and equipped with a floor area of 17,000 sq ft and containing metallurgical, physical and chemical laboratories and high speed, tool steel, piston and general heat treatment sections.

Among the equipment are various hardness testing machines, a Reichert M.E.F. camera microscope, a Watson Holophot microscope, metallographic mounting and polishing machines and a Dennison tensile testing machine. Heat treatment of high speed steels, highly alloyed steels and tool steels is carried out by use of Birlec, G.E.C., and E.F.C.O., batch type furnaces, Birlec forced air circulating tempering furnaces, Birlec-Cassel salt bath furnaces, and Shorterizing equipment. Also included are machines for vapour-blasting, shot-peening and shot-blasting. Equipment for the heat treatment of constructional case-hardening includes Wild-Barfield drip-feed gas carburizers, E.F.C.O. salt bath furnaces, Birlec 110 kW pack carburizing furnaces and various types of oil quenching machinery. Spenstead rotary shot blast equipment is used for general shot blasting operations. Hardness testing equipment used includes Brinell, Rockwell and Vickers machines and Shore scleroscopes.

Creep Information Centre

The Creep Information Centre which is being set up at the National Engineering Laboratory (formerly the Mechanical Engineering Research Laboratory) at East Kilbride, will provide industrial designers more readily with data on the strength of high-temperature materials. It is expected to become the national centre for information on the strength of high-temperature materials and interested organizations have been invited to co-operate in supplying experimental data so that the scheme may become fully effective.

The main object will be to collect and tabulate all the available data on creep and rupture properties of conventional high-temperature materials. Data for British materials will be issued in an agreed form as far as considerations of commercial security allow. The scheme will later be extended to include fatigue and other mechanical properties of high-temperature materials and information about test procedures and testing machines; data on foreign materials may also be included.

A leaflet giving further details of the scope of the Creep Information Centre is available from the laboratory. All firms and research organizations concerned with the production or use of high-temperature engineering materials are invited to participate, and to write to the Director, National Engineering Laboratory, East Kilbride, Glasgow.

Date Line for Stokers

The announcement by the Ministry of Housing and Local Government

The new heat treatment department of Holman Brothers Limited at Camborne, Cornwall, is extensive and well equipped. At left are Wild-Barfield drip-feed gas carburizers: three boxes containing rock drill parts which have been case-hardened are being taken out of the retort and moved to the right ready for lowering into the after-cooler in the foreground. At right, rock drill parts removed from the Birlec 70 kW furnace in the background are being dropped into the oil coolant tank for controlled cooling

that coal-burning furnaces fired by mechanical stokers which were installed on or after December 31, 1956, are to be given a general exemption in smoke control areas means that a valuable market for British coal will be preserved without detracting in any way from the national policy to reduce pollution.

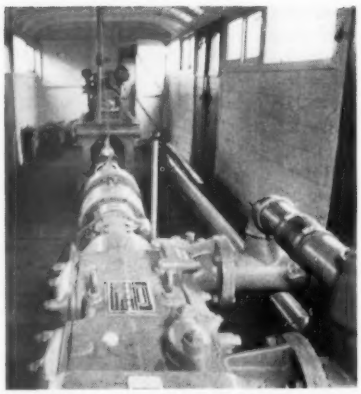
In smoke control areas created under the Clean Air Act, 1956, many local authorities have already granted specific exemptions for mechanically fired coal-burning furnaces, but the Coal Utilization Council and the Combustion Engineering Association have been concerned at the lack of a general exemption. They had represented jointly to the Ministers of Power and of Housing and Local Government that this situation was unsatisfactory, since industrialists and others were unlikely to install new mechanically fired coal-burning plant, however efficient and smoke-free, in a smoke control area unless the local authority made an amending order. The delays and uncertainties involved in this were a serious discouragement to the installation of modern and efficient coal-burning appliances, although these were capable of being operated as smokelessly as oil-fired appliances, which had already been granted a general exemption.

Weedkiller Train

A new train, specially designed to spray chemical weedkiller on railway track, has been brought into service on the Western Region of British Railways. Similar trains have been used on the railways of this country for more than twenty-five years, and while the new train introduces no major new principles, it incorporates several refinements which permit more efficient and economical operation, including the use of a Megator pump.

The train, which is the third to be built since the war by Chipman Chemical Company Limited (2 Caxton Street, London, S.W.1), is able to treat up to 68 miles of track before needing to take on fresh supplies. Weedkiller solution is carried in four tank wagons, each with a capacity of about 4750 gallons, and is sprayed on the track at the standard rate of 280 gal a mile, although this rate of spray can be adjusted to suit special conditions.

In addition to the tank wagons, the train comprises a spray van, which houses the pump and other machinery, and a messing coach,

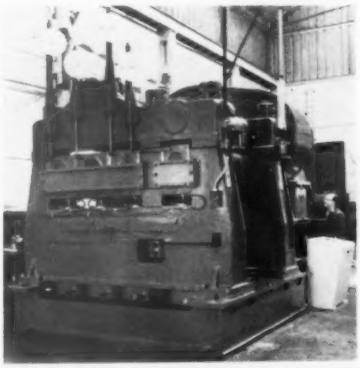


The interior of the spray van on the new Chipman weedkiller spray train showing the machinery layout. In the foreground is the Megator type GH4 pump, which draws solution from the tank wagons and pumps it through the spray nozzles, and behind this is the reversing clutch and lever, and the gear-box which takes the drive from one of the train axles. On the stand at the back is the petrol engine and drive to the compressor which provides air to the tank wagons for agitating their contents. The 4-in. pipe carrying the weedkiller solution can be seen on the right

converted from old L.N.E. passenger stock, in which the operating crew, normally of three, eat and sleep during the spraying season. A workshop for maintenance and running repairs is located in the spray van. A guard's van is attached to each end of the train so that it can be worked in either direction.

All vehicles on the train are close-coupled and equipped with twin cylinder vacuum brakes. Roller bearing axle boxes are fitted to all the tank wagons.

The optimum spraying speed is 20 mph, when the solution is delivered at the rate of about 93 gpm. The solution is drawn from the base of the tanks through a 4-in. pipe which runs alongside the tank wagons, under the messing coach and into the spray van. Here it passes into the pump, and on through several smaller lines to various divisions of the spraying booms. Between vehicles the four-inch line is connected with Fulflex hose couplings.



HEAVY DUTY PLATE LEVELLING AND STRAIGHTENING MACHINE.—Built for a British bridge and engineering works by The Bronx Engineering Company Limited, Lye, near Stourbridge, this machine will deal with plate up to 3 ft wide and 3 in. thick for straightening, and up to the same width and 2 in. thickness for side bending. It will also level plates of down to ½ in. thickness. There are two pinch rolls, the lower being adjustable, and five levelling rolls, the lower three of which are adjustable. Change mechanism gives levelling speeds of 15 and 20 ft per min. The machine is arranged for reverse levelling under full load

The spray booms at present fitted are arranged to spray a total width of 17 ft 6 in.: a fixed boom covers the inside track portion, and swivel booms extend from each side of the spray van to cover the rest of the width. These swivel booms are controlled during spraying by an operator who sits in the van at a window directly above the point of attachment, and uses a hand lever to swing the boom in to avoid any obstacles on the route.

One of the innovations on the train is the duplication of the spraying booms across the full width. Each of the two systems is arranged to give the correct spray pattern when the train is travelling at ten miles an hour, so that when the speed is reduced below this figure, as in the treatment of sidings, etc., one of the spray systems is turned off, giving correct delivery across the entire width of spray.

A Megator type GH4 pump supplied by Megator Pumps & Compressors Limited (43 Berkeley Square, London, W.1) is used on the train. It requires only a small amount of very simple maintenance, a factor of some importance in this use, and it is suitable for handling weedkiller solutions containing powders in suspension. Over the range of speeds at which the train operates, the pump capacity is directly related to the speed, so that the correct amount of solution is always sprayed on to the track. This is achieved by driving the pump from one of the train axles. A V-belt system connects the axle with a gear box, and the drive is transmitted to the pump through a marine-type reversing clutch, which enables the flow to be kept positive regardless of the direction in which the train is moving.

The swivel portions of the spray booms are attached to the train by means of shear-pins fitting into brackets. In this way if the boom encounters an obstruction it breaks off easily without damaging either the boom or the bracket. The booms can also be easily removed for cleaning or maintenance.

In all, there are 22 spray nozzles fitted on the booms, of the Watson hollow cone type, and these are fed

through a total of ten feed lines each equipped with a cut-off valve, so that different sections of the track can be sprayed as required. Shoes fitted under the spraying boom prevent the liquid falling on to the rail heads.

Inside the spray van are a spray mileage recorder, giving daily and summary totals of the length of track treated, a speedometer, and pressure gauges.

Giant Transformer

The highest rated power transformer of its class to be made in Great Britain is being installed in Skelton Grange substation, near Leeds, of the C.E.G.B. Yorkshire Division. The transformer is rated 180 MVA, 275/132 kV and will be used for the Super Grid; it is the first of four of similar rating ordered by C.E.G.B. from BTH (whose transformer interests are now integrated with those of Metropolitan-Vickers in the Associated Electrical Industries Transformer Division). One of the remaining three is for Skelton Grange and the other two are for West Melton, near Sheffield.

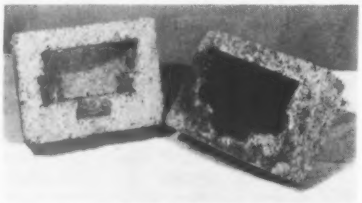
These transformers have been designed, and the first one has satisfactorily passed impluse test, for an impulse level of 1050-kV full wave on the H.V. winding and 550-kV full wave on the L.V. winding. The transformer is constructed with shielded cylindrical layer type H.V. windings. All coils are wound with rectangular stranded cable, giving low stray loss, coupled with great mechanical strength. The cores are constructed of cold reduced grain oriented silicon iron. The on-load tap changing equipment is at the 132-kV line end of the winding and is of the high-speed resistor transition type, similar to many previously supplied for transformers connected to the Super Grid and already in service.

Fuel Transportation

Speaking at the annual dinner of The Council of British Manufacturers of Petroleum Equipment, Dr. James Burns referred to the transportation of fuel in Britain and offered a prediction on how this is likely to develop. Remarking that at the present time the major portion of our coal and oil raw materials in the gas industry, are transported to the point of usage, he said the situation has now arrived when it is no longer economic to transport these materials overground, but rather to transport the products in the form of gas underground by pipeline. "Thus with coal as a raw material it is likely that plants of the future will be placed on the coalfield with minimum transportation charges, with oil or oil products transported thereto by pipe-line to produce a gas suitable for national distribution, while at the great oil receiving centres of the country, there will be set up plants both for base load and peak load purposes, using oil as a raw material, and again feeding into a countrywide distribution system."

Tailor-made Packing

Bespoke tailors in the packaging field, Proteccopack Limited have opened a new London factory for manufacturing highly resilient moulds to individual order. The low priced packs cut space and packing time in addition to preventing damage and breakage.

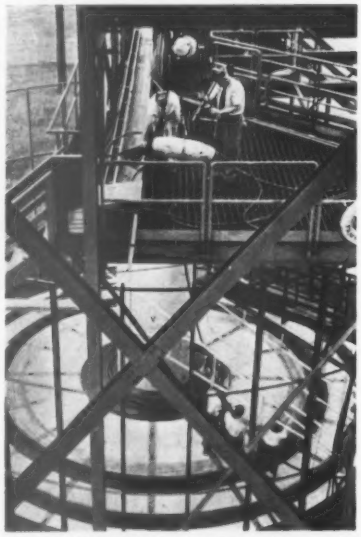


An air cooled cylinder packed in a Proteccopack mould. Giving complete protection, the moulds are individually made for each product

The moulds have been submitted to stringent tests and filled Winchester bottles, packed in their moulds, have been dropped on to concrete from a height of 50 ft without damage, and fragile goods have withstood loads of 1,000 lbs stacked on top of them.

The moulds are individually made for each new type of product and make for simpler packing and further reductions are possible if articles are packed in the multi-seat system.

The moulds can be made returnable for the home market. While several journeys are normal, up to thirty journeys have been recorded on some packs. Proteccopack Limited, an associate company of W. Lusty & Sons Limited, supply fibreboard, softwood, or plywood outer cases to give longer life to moulds which are to be used for several journeys in the United Kingdom or for additional protection for overseas trade.



"C.S. FANTASTIC".—Simulated undersea cable-laying activities are shown on two levels of a hill top laboratory (the "cable ship" Fantastic) at Bell Telephone Laboratories, New Jersey. On deck, engineers place a cable repeater model in the "high-way", ready for launching, while below others work out methods of stowing cable in the "tank". The cable ship mockup will help in the development of new ship-board equipment and methods of handling repeaters and cable systems. The hilltop location was chosen to give an adjacent lower level to simulate cable laying at depth

Electropol Development

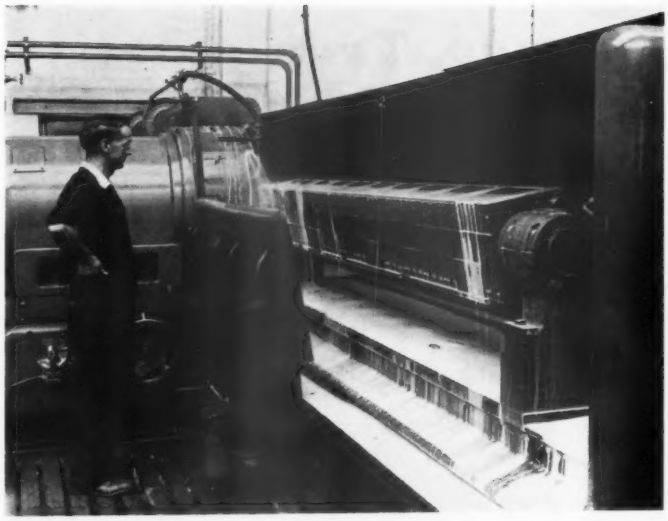
The new extension to the factory of Electropol Processing Limited at the Farnham Trading Estate, Surrey, will treble its present capacity. This is the fourth extension since 1952 when Electropol moved from the Nissen hut opposite the Bourne Mill of Domesday Book fame at Farnham seven years ago. The new extension of 13,000 sq ft designed and constructed by Hewitts of Cranleigh, will considerably increase the facilities for the Electropol processing of stainless steels.

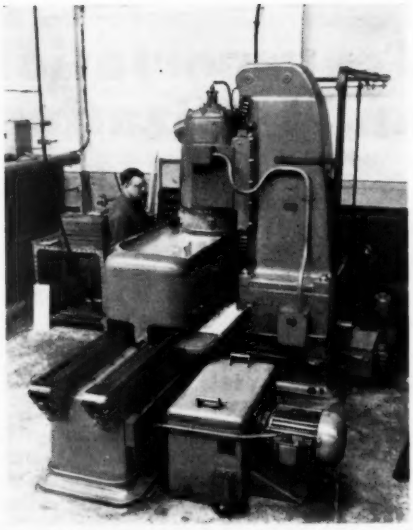
During the past ten years Electropol has electro-polished tens of millions of products fabricated in stainless steels. For one motor accessory manufacturer alone it has processed 15 millions of one product. The process has already proved itself extremely successful in those industries where permanently clean surfaces and containers are essential.

The process was developed and patented by Electropol Limited, of Poynton, Cheshire.

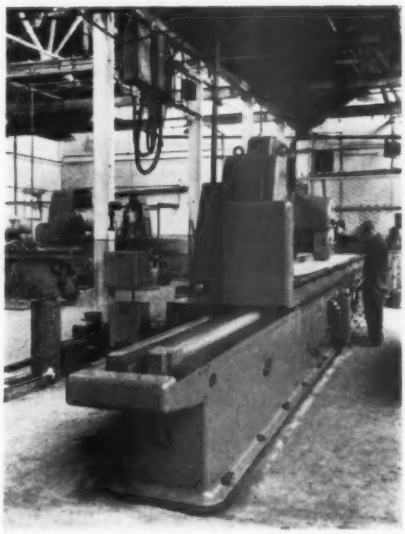
Plant Insulation

The largest insulation contract ever carried out in Eire has been completed at the new oil refinery at Whitegate, Co. Cork, by M. A. Boylan Limited, a subsidiary of The Cape Asbestos Company Limited. The total amount insulated was 74,845 ft or over 12 miles of piping, and 50,000 sq ft of vessels, towers, etc. The piping was insulated with Caposite amosite asbestos sections, finished with an asbestos





New 32 in. head segmental grinder used for flat siding, edging or bevelling shear blades and guillotine knives. Right, vertical head segmental grinder used mainly for edging and flat siding ground flat stock which is then finished on open side surface grinder



Left, large open side surface grinder. Capacity 18 ft long × 18 in. wide. Right, part of the precision grinding section showing one of the new machines, an open side grinder capable of producing plates up to 6 ft × 3 ft

based felt. The towers, chimney stacks and vessels were insulated with Rocksil mattresses and slabs and finished with aluminium sheeting. M. A. Boylan Limited have in recent years developed their own cleading technique for finishing the insulation of large tanks.

Precision Grinding Plant

The Attercliffe Steelworks at Sheffield of Sanderson Brothers and Newbould Limited has recently been the scene of a notable expansion in the company's machine knife department. Sanderson's are one of the oldest machine knife makers and are large manufacturers of precision ground tool steel flat stock and the recent developments reflect the rapidly increasing demand for the company's products both at home and overseas.

Of particular interest is the variety of new grinding machinery installed. Among these (several are illustrated on this page) are three segmental grinding machines, one of which is a large 32 in. machine for flat siding, edging and bevelling shear blades, guillotine knives and similar blades. The other two are vertical head machines; one for sharpening and bevelling shear blades, guillotine knives and straight knives in general; and the main use of the other is for edging and flat siding ground gauge steel before finishing this material on open side surface grinders, but some knives will also be ground on this machine.

Of two new open side grinders, one is fitted with specially designed magnetic chucks; the capacity is up to 18 ft. in length and 18 in. in width. The other is for producing ground plates up to 6 ft by 3 ft. A heavy duty universal grinder has been installed for the production of slitting cutters and other circular plates up to 24 in. dia.

Transportation, Storage, Treatment, and Utilization of Liquefied Natural Gas

The British gas industry has been built up during a period of over 150 years with coal as its basic raw material. Conditions have now developed in which it has become difficult to obtain sufficient coal of the particular types suited to gas making, and the Gas Council is now carrying out large scale trials on the importation and utilization of natural gas from oil-bearing countries

By A. R. MYHILL, F.R.I.C., M.Inst.Gas E., M.Inst.F.

UNTIL comparatively recently, the supply of town gas in Britain has been from gas produced by the dry distillation of coal, plus a certain proportion of water gas made from coke, using petroleum oil as an enriching agent. Since nationalization of the gas and coal industries, it has been necessary to investigate the possibilities and economics of supplying gas from other materials and by other processes.

There are many reasons for this, involving complex technical, political, and economic considerations, but an outstanding factor is that the special coals needed for making gas by conventional methods of carbonization are in increasing demand for other purposes, with the result that there is a shortage of supply for gas-works use. A considerable amount of gas is now being made in several of the larger gas works by the new catalytic processes, using oil products produced in British refineries. Although this has considerably eased the coal situation, other avenues are being explored and serious consideration is now centred on the possibilities of utilizing natural gas, following American practice where, in the United States, over 97% of the gas used is derived from this source. Pipeline transmission of such gas over very long distances is common practice, as, for example, the New York supply which is fed from Texas and other states over 1500 miles away.

Fig. 1.—The "Methane Pioneer", the vessel which brought the first shipment of liquid natural gas to Canvey Island, Essex, tied up on arrival at her jetty on February 20, 1959

Occurrence of natural gas

Gas is associated in nature with oil deposits, where it accumulates in rock reservoirs in large volumes at very high pressures, often exceeding 2500 psi. No appreciable deposits of natural gas have yet been found in Britain, but the possibilities of importing it from oil-bearing countries have been under consideration for some years. Natural gas consists mainly of methane (known to coal miners as "fire-damp") and has a calorific value of about 1000 B.t.u. per cu ft as compared with 450–500 B.t.u. for normal British town gas. Its composition varies according to the location and type of deposit. The following is a typical analysis:(1)

Carbon dioxide (CO_2)	0·8%
Methane (CH_4)	91·0%
Ethane (C_2H_6)	3·1%
Propane (C_3H_8)	1·7%
Butane (C_4H_{10})	0·7%
Nitrogen (N_2)	2·7%
Calorific value ...	1047 B.t.u. per cu ft
Specific gravity (air=1·00)... ...	0·61

With the exception of negligible quantities of "permanent" incombustible components (carbon dioxide and nitrogen), natural gas consists, therefore, of a mixture of hydrocarbons ranging from methane, which is normally considered as a permanent gas, to substantial proportions of heavier substances which are gaseous at ordinary atmospheric temperatures, but which can be liquefied by the application of low temperatures and/or moderately increased pressures. Liquefaction therefore represents a feasible method for storing and transporting natural gas, and possesses the great advantage of thermal concentration in a small volume. A considerable range of choice is possible regarding the scheme employed. Up to the present time, liquefaction by high pressure rather than by very low temperature has been the means most favoured, but there is now a move to apply low temperature techniques for large-scale transportation. A great deal depends on the proportions of the different hydrocarbons present in the mixture, and on the ultimate market requirements of the product. In some cases, for instance, certain fractions may be isolated for special purposes such as to provide raw materials for chemical manufacture, and the remaining fractions used as fuel gas.

The heaviest hydrocarbons occurring in any considerable quantity are the butanes. "Normal" butane liquefies under atmospheric pressure at 31°F and can be retained completely in the liquid form at 100°F if the pressure is maintained at 37 psi gauge. Propane, a lighter hydrocarbon, requires a temperature of —44°F

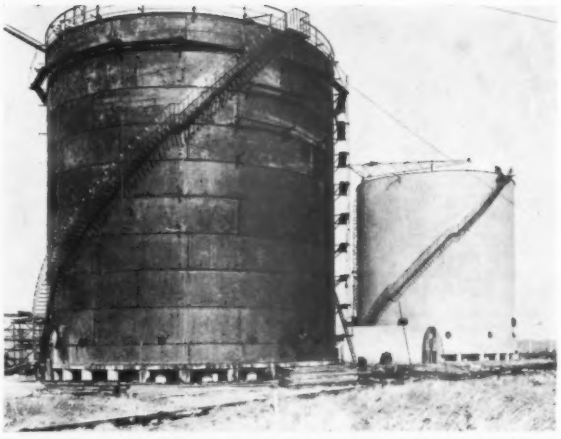


Fig. 2.—The two 1000-ton storage tanks on the riverside at Canvey Island. These hold the liquid methane before re-gasification

for liquefaction under atmospheric pressure, or a pressure of 175 psi gauge for liquefaction at 100°F. Methane liquefies at —162°C under atmospheric pressure and has a critical temperature of —82°C at which the pressure must be maintained at 680 psi gauge. It is possible, therefore, to obtain liquefaction at any temperature within this range according to the pressure decided upon.

Natural gas occurs in dry wells, wet wells, and crude oil reservoirs. The gas from a dry well, where there is no oil, contains over 90% of methane, with the remainder of ethane, propane, butanes, and heavier components. These latter are often liquefied on the site, and retained in tanks, rail cars and boats, while the lighter constituents, methane and ethane, are transmitted by pipeline as gas. In wet wells (often known as "condensate reservoirs") the gas is located partly above the surface of the oil and partly in solution under high pressure, and may contain 60 to 90% of methane.

When the pressure is released, methane and ethane are evolved as first products, the oil retaining a considerable proportion of the heavier hydrocarbons. These latter are later driven out of solution during distilling operations at the oil refineries, and constitute part of the so-called "refinery gases". In crude oil reservoirs there may be no gases above the surface of the oil, which is under high pressure in closed caverns. All the gas may therefore be dissolved in the oil, and the methane, etc., is released when the pressure of the liquid is reduced at the well-head prior to loading. Operations are controlled to retain as much gas as possible in solution by letting down the pressure in stages. Some gas is liberated at each pressure-reduction, and the proportion of methane contained in it falls as the pressure becomes less. Gas derived from this source is geared directly to oil production. The gas yield may be of the order of 5–15 cu ft per gallon of oil (2)(3).

The advantages of liquefaction of natural gas will be appreciated when it is realized that the thermal concentration is increased to give a fuel which occupies only one six-hundredth of its volume in the gaseous state.

Liquefaction of gas

Techniques for the production of low temperatures and their application to the liquefaction of gases are well known, and comprise three main systems: (2)

(a) The Linde process, which employs the principle of simple expansion of the gas through a nozzle, a heat exchanger being provided to pre-cool the compressed gas before expansion.

This system, employed for liquefaction of natural gases for transport by special barges on American inland waterways, is often extravagant in fuel consumption, depending on details of plant design. This may reach 35% (although it is possible to reduce it to below 10%) of the thermal value of the gas liquefied.

(b) The Expansion System, developing external work, in which expansion engines in place of a throttle valve are used. In this method the expanding gas is caused to do work in the engine or turbine and a greater reduction in temperature is produced. In addition, the power developed by the turbine can offset part of the power necessary to drive the compressor.

(c) The Cascade System. This employs a series of refrigerants having progressively lower boiling points. There are two or three closed expansion cycles for the gas, operating in series with each other at different temperature levels. Water, ammonia, ethylene, and methane, in this descending order of boiling points, are typical substances used as refrigerants, expansion values being located between the stages.

This system is employed at Cleveland, and works with a fuel-gas consumption of 24% of the gas liquefied.

British experiments

Early in 1958, the Gas Council of Great Britain decided that circumstances were propitious for carrying out a large scale trial on the feasibility and economics of importing liquefied fuel gas from oil-bearing countries. While it is obvious that the incorporation of such a scheme into future normal practice would be determined by its economics, the trial was inaugurated in the first instance mainly to obtain experience of the new techniques involved. The transport of liquefied gases by road, rail, and inland waterways is practised commercially in America, and considerable information has been made available to British pioneers, but until this year no one has had any experience of conveying thousands of tons for thousands of miles in ocean-going vessels.

Accordingly, plans were made for the conversion of an oil tanker, the "Normati", originally sailing under the Liberian flag, for the purpose of carrying about 2000 tons of liquefied natural gas from America to England. The vessel, after conversion, now jointly owned by The Gas Council of Great Britain and Constock International Methane of the U.S.A., and re-named "Methane Pioneer", left the Gulf of Mexico for its journey across the Atlantic on January 31, 1959, carrying 2000 tons of liquid gas, and arrived without-mishap at Canvey Island, Essex, on February 20. Within a few days of its arrival the first load was put into storage tanks, gasified, treated to make it suitable for mixing with normal town gas, and passed into the normal London supply.

Novel features were encountered in connection with the transportation of the liquefied gas, and its handling at the British port. Among them may be mentioned:—

(a) Modifications in the construction of a conventional oil tanker to make it suitable for shipping a liquid gas
(b) Loading the ship from land storage tanks
(c) Storage losses during the voyage
(d) Unloading and storing liquid gas on arrival at Canvey Island
(e) Gasification of the liquid
(f) Distribution of gas by pipeline

(g) Treatment of gas to make it suitable for mixing with the normal London town gas.

Construction of the "Methane Pioneer"

Before conversion the ship was an oil tanker designed to carry a cargo of 3500 tons. Since the thermal stowage capacity of methane is only about 60% of that of oil, and allowing also additional space for the special tanks and insulation, it was not possible to carry more than 2000 tons of liquefied gas. The vessel is 339 ft long and has a 50 ft beam. It is driven by diesel engines and has a speed of 11½ knots. The design and engineering work for the conversion was handled by J. J. Henry and Company, of New York, and the work was carried out by the Alabama Dry Dock and Shipbuilding Company Inc. at Mobile, Alabama, U.S.A. The liquid methane is contained in five welded aluminium tanks, insulated by 12 in. lagging of laminated balsa wood. Each tank has a steel jacket enclosing the insulating layer. The approximate dimensions are 40 ft long, 30 ft wide and deep for each tank. The positioning of the tanks was an important consideration in view of the considerable amounts of distortion and deflection which might be expected in heavy weather. Accelerations of the ship in rolling and pitching may exceed 1·0 g, resulting in an increase in effective weight of the tanks and contents to double their normal value. Rolling accelerations are related to the "stiffness" of the ship, as determined by the metacentric height, so that it is advisable in a vessel of this nature to have an easy roll associated with a low metacentric height, thus minimizing the energy imparted to the liquid due to ship movement. This is important to prevent excessive "boil off" of gas from the liquid. (2)

In the "Methane Pioneer" three of the tanks are in the original forward-hold and the other two in the after-hold. In view of the low specific gravity of the cargo, the vessel is specially ballasted.

Loading the ship from land storage tanks

In order to foresee any technical difficulties which might be expected in unloading the ship on arrival at Canvey Island, special tests of pumping equipment, etc. were carried out in America when the vessel was loaded at the methane liquefaction plant at Lake Charles. The ship's tanks were successfully filled, and afterwards the liquid methane was pumped back to the land tanks and then again back to the ship. Much useful information was thereby obtained which ensured safe and easy unloading in Britain.

Storage losses during the voyage

Some loss of gas through "boil-off" during the voyage is inevitable. The gas pressure above the liquid in each tank is about 2 psi. Boil-off gases can be dealt with in several ways, and these are now being investigated. The simplest method is straight venting at the mast, and in the case of the "Methane Pioneer", a limit of 0·5% of the weight of cargo might be expected during the voyage, but considerable variation is possible and could reach several times this amount in rough weather. The second method is to use the escaping gas as fuel for the ship either supplementing the normal oil supply or providing all the fuel in this way.

The third method, which has been suggested but not yet put into practice, is to re-liquefy the gases and return the liquid to storage.

Unloading and storage

Fig. 2 is a photograph of the two 1000-ton storage tanks for liquid methane which have been constructed

Fig. 3.—The pipeline being laid across the creek from Canvey Island (in foreground) to the Essex mainland, where it has been linked up with the high-pressure main which brings refinery gas to Romford from the oil refineries at Shell Haven and Coryton

to receive the cargo from the "Methane Pioneer" on the banks of the river at Canvey Island. It has been recognized that the paramount factor of liquefied gas storage is insulation, and these tanks, each of which is two-and-a-half times the capacity of each single tank in the "Methane Pioneer", have been constructed of aluminium to a specification determined by the North Thames Gas Board in conjunction with the builders (Whessoe Limited of Darlington, and The A.P.V. Company Limited, of Crawley).

The tanks are among the largest aluminium vessels of this type to be built in Britain. They are of welded construction and the welding was radiographed throughout on site. The initial filling of the tanks during the week or so following the ship's arrival, took considerably longer than it is expected will be necessary for future deliveries, since it was carried out sufficiently slowly to permit testing at different stages of unloading, using the same specifications as were used in the tests carried out at Lake Charles when the ship was loaded and unloaded. In subsequent deliveries, the fact that the receiving tanks will contain methane at a very low temperature, instead of at air temperature, will enable a much higher pumping rate to be employed.

A serious problem presents itself in the discharge of a liquid at such low temperatures from ship to tank, since flexible hoses have to be used, and increase in temperature in the delivery pipes must be avoided. The hose (Compoflex) used, was of 7 in. bore with a 6 in. covering of thermal insulation.

Although the shore storage tanks are heavily insulated, there is a continuous boil-off of methane from the liquid and the gas is conserved in a small gasholder of the Wiggins waterless type, whence it may be pumped into the mains system.

Gasification and pipeline distribution

For distribution to the Board's transmission lines as gaseous methane, a simple heat exchange system is used for vaporizing the liquid, water or steam being employed as the heating medium. Gasification of the liquid takes place under pressure, and this pressure is used to convey the gas to and through the mains.

Although possibilities of making commercial use of the "cold content" or refrigerating capacity of the

Fig. 4.—A pre-fabricated length of the pipeline consisting of over 1000 ft of 16 in. welded steel tube with a covering of concrete. This was laid in the creek-bed in one operation. Note the air-drums lashed along its length to give buoyancy during laying

methane have been considered, this has not been put into practice at the present stage.

The lay-out and construction of the pipeline system has been the subject of considerable discussion by the North Thames Gas Board, since it has become part of a larger scheme involving purchase and treatment of oil-refinery gas from the ports of Shellhaven and Coryton.

Oil-refinery gas, consisting of gaseous hydrocarbons of various compositions and containing considerable proportions of free hydrogen, methane, propane and butanes, has a variable calorific value, usually within the range of 1000–2000 B.t.u./cu ft, i.e. generally considerably higher than that of natural gas. It is produced as a by-product in the manufacture of petrol and other products, and finds a ready market as raw material for the gas industry. In 1956 an agreement was made between the Shell Refinery and the Gas Board to supply and receive the surplus refinery gas into the board's mains, and this has now come into operation. A high-pressure main is now taking refinery gas from Shellhaven to the gas-works at Romford, about 17 miles distant.

This main was constructed with the possibility in view of accepting natural gas into Canvey, where the board owns land with deep-water-berthing on the river. A new pipeline has now been constructed from Canvey to connect with the main carrying the refinery gas, and the mixed gases pass to Romford for treatment subsequent to delivery into the London area of supply.

The laying of the new pipeline presented some interesting features since part of it had to be laid across the creek from Canvey Island to the Essex mainland. Fig. 3 shows a view of the main in which over 1000 ft of 16 in. dia welded steel pipe, with a covering of concrete, was laid in one operation. To give it buoyancy, air drums were lashed along its length and the pipe was then hauled as a pre-fabricated unit across the creek. The drums were then released by a ripcord and the pipe settled in the bed of the creek. Finally a special machine scarified the creek-bed and buried the pipe to avoid risk of danger to passing craft.

Mixing with town gas

As stated above, natural gas possesses characteristics which are considerably different from those of normal British town gas. From the point of view of utilization, the most important of these are calorific value, specific gravity, and air requirements for complete combustion, and these affect storage, distribution, and use.

In Britain, sizes of gasholders, diameters of mains, and distribution pressures are related to calorific value and specific gravity, and consumers appliances are designed to burn gas of definite combustion characteristics. These latter are calorific value, specific gravity and air requirements, all of which affect not only the gross thermal output but also the thermal efficiency of the appliance. Thus in a country where raw natural gas is in standard public use, as in some American states, appliances made to British requirements would not function satisfactorily.

In accepting imported natural gas as a considerable proportion of the supply to any area, these factors must be taken into account. In the case of the liquefied gas received at Canvey Island, therefore, it has been decided that it would be highly inadvisable to pass the gas directly into the town mains. This decision, incidentally, also applies to the refinery gases received from Shellhaven. In the course of discussion on this matter (4) it became necessary to decide whether the imported natural gas and the refinery gas should be treated to produce town gas at Canvey and/or Shellhaven, or whether these "rich" gases should be transported direct to Romford for treatment at the gas works. The latter alternative was adopted for several reasons. In the first place, costs of distribution per therm of rich gas and per mile of pipeline are considerably lower on account of the greater thermal concentration, and, secondly, the presence of an available supply of high calorific value gas in the high-pressure main gives a valuable degree of flexibility in use. Thus such gas can, if necessary and economical, be used to augment town supply not only by direct "reforming" at Romford, but also by:

(a) Cold enrichment of blue water gas from, say, 300 B.t.u./cu ft to 500 B.t.u./cu ft to displace gas oil otherwise necessary, at times when oil prices are high

(b) Influencing availability of coke (as, for example, to implement the requirements of the Clean Air Act) by controlling the extent of operation of carburetted water-gas plant.

It will be seen, therefore, that there are several ways in which the methane can be used as raw material for augmenting the normal town gas supply.

In general, the process of "reforming" as adopted at Romford is likely to become standard practice under present market conditions. Other methods are those involving simple addition of the rich gas to other gas of low calorific value, such as blue water gas, producer gas, or "steamed" or debenzolized coal gas, to produce a mixture having a calorific value of (in the case of London gas) 500 B.t.u./cu ft. Methods of simple dilution, how-

ever, have the disadvantage that, although it is an easy matter to produce a mixture of any required calorific value between the limits of the constituents, it is not generally possible to use more than a comparatively low proportion of such mixture in the final gas, since higher amounts would affect characteristics other than calorific value (e.g. specific gravity and air requirements) which would be reflected in the performance of consumer's appliances.

The reforming process

"Reforming" is a process in which a gas or vapour consisting essentially of hydrocarbons, such as natural gas, refinery gas, etc., can be converted into gas of any desired lower calorific value, at the same time producing a product which has other characteristics sufficiently similar to those of coal gas as to make it suitable for mixing with the latter in any proportions.

The chemical principles underlying the process are that hydrocarbon gases, under the action of heat and in the presence of air and/or steam, are decomposed with the production of other hydrocarbons of lower molecular weight, accompanied by free hydrogen, carbon monoxide and small quantities of carbon dioxide and free carbon. A high reacting temperature is necessary to effect efficient reforming. The necessary temperature in practice may be attained by external heating with gas or oil fuel or by internal heating, using air to supply oxygen to the reacting substances. The process may therefore be endothermic, when steam is used, or exothermic, when air is used, and, usually, exothermic and endothermic reactions are proceeding simultaneously. Reforming may take place either with or without the presence of a catalyst, and most modern plants employ a catalyst. The plant at Romford is cyclic catalytic, operating on the Onia-Gegi principle, and was constructed by Humphreys and Glasgow Limited.

A special nickel catalyst is used. The cycle is controlled and operated entirely automatically by cam-operated relays, and allows of considerable variations in the rreactions taking place, so that it is possible to produce gas of any desired composition between wide limits and to deal with wide variations in the composition of the rich gas treated. The cycle is of about 5 min duration and consists, in principle, of two main phases, the heating phase in which the reaction chamber is brought to the optimum temperature, and the reforming phase in which the rich gas is passed over the heated catalyst in the presence of steam. Heating of the plant vessels takes place by burning part of the gas in a pre-heated air blast. In a typical cycle, about 30% of the time might be occupied in heating up, after which the air-blast would be shut off. This would be followed by a short "make purge" of, say, 5% of the time, during which period steam is passed through the plant in the same direction as the heating gases to sweep out the products of combustion to the waste-products stack. The reforming phase follows, commencing with the opening of the process gas valve, and lasts for about 60% of the cycle. The waste-products stack-valve is closed and steam admitted with the process gas, the mixture being preheated by passage through a chequer-work system constructed of refractory brickwork, previously raised to red heat during the heating (air-blow) phase. A certain amount of thermal reforming takes place during this stage without catalytic aid, but the main reforming reactions take place in the first catalyst bed which is located, not in the so-called "reactor" which follows next in the flow series, but in the upper part of the steam preheater. The reactor, containing the bulk of the catalyst, is a cylindrical mild steel vessel, lined with refractories. Gas and steam from the steam preheater, after passing through the first catalyst bed, enter the reactor at the top; pass downwards through the second catalyst bed in the reactor, which is designed to promote intimate contact and large surface area between the partially reformed gas, steam, and catalyst, and the gas is here finally reformed to the extent required. The amount of time contact, the temperature, and the relative proportions of gas and steam, determine (among other factors) the calorific value and composition of the final gas. After reforming, the gas passes through a waste heat boiler, designed to recover heat as steam from the hot gas, and thence to a wash-box and ancillary gasworks plant.

A short time before the end of the reforming phase, the process valve is closed, leaving the steam to "purge" the residual reformed gas forward.

Then follows the "blow purge", lasting for the remainder of the cycle (say 5% of the total time). During this short period, with the process steam valve closed, air and rich gas are admitted to the plant, the combustion products passing forward with the reformed gas remaining in the vessels for a short time before the main stack valve opens, and the cycle commences once more.

The Onia-Gegi plant at Romford has a remarkable flexibility of output range, coupled with ease of control and adaptability to varying qualities of feedstock. As an example, it has been found practicable to vary the output from one unit, between 5 and 13 million cu ft per day, without serious losses in thermal efficiency.

In view of the intermittent or cyclic nature of the process of reforming, it is obvious that there must be some thermal losses in the conversion of rich gas into town gas. These losses arise because of the necessity to supply heat to a process which, on balance, is endothermic. Some of this heat is lost as stack gases during the "blow" or heating-up period, although a very considerable proportion is recovered from the sensible heat of both combustion gases and reformed gas by passing these products through a waste-heat boiler.

Added to this are small losses of natural gas during transport and unloading. Natural gas in its original state has an equivalent of about 530 therms per ton. Allowing for conversion and handling losses, the value to the British gas industry may be reckoned as about 480 therms per ton, i.e. a loss of, say, 10% in thermal value.

The trials so far carried out on the importation and utilization of natural gas have been eminently satisfactory from the point of view of technical practicability.

The "Methane Pioneer" has returned for further loads in order to allow all relevant data to be obtained as a guide to future plans. From the technical and economic points of view, it will be necessary to give consideration to the importation of liquefied methane on a much larger scale, and it is likely that vessels of, say, 30,000 tons will be needed in order to secure real economy.

In conclusion, the writer wishes to acknowledge assistance given in the preparation of this article by the Press and Information Office of The Gas Council.

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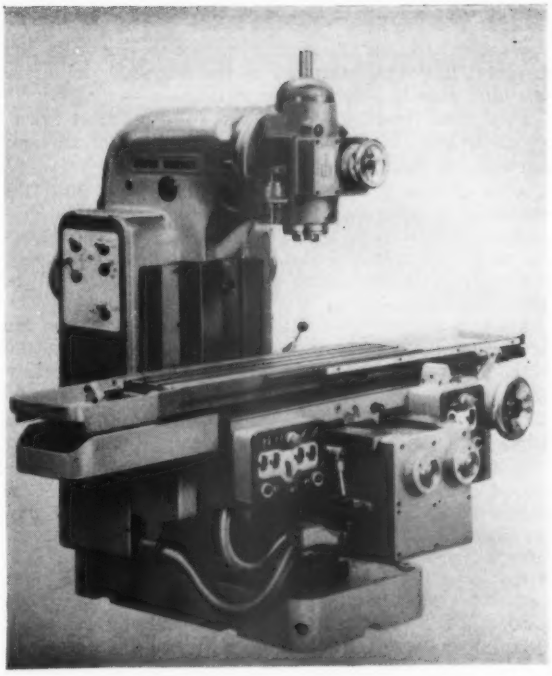
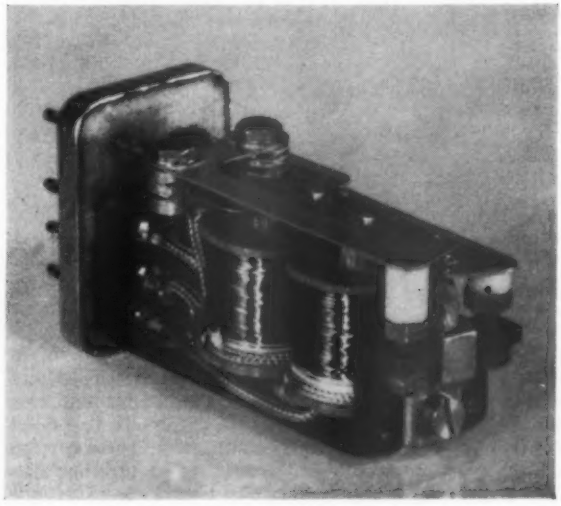


The new Model FV2 Fritz Werner vertical milling machine with finger-tip control of all movements

Milling Machines with Finger-tip Control

The range of Fritz Werner finger-tip controlled milling machines for which The Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London NW2, are the sole United Kingdom selling agents, has been increased to twenty-six machines by the introduction of six new models, two each horizontal, universal and vertical. These new models have many advanced features in common with the larger machines introduced earlier this year, including control of all movements by directional finger-tip switches, seventeen automatic cycles selected by column switches, automatic cut-out of feed when spindle speed falls below selected rpm, etc.



The heavy duty Size 1D machines have 43 in. × 11¾ in. tables with a longitudinal traverse of 25½ in. and the standard Size 2 machines have 53 in. × 11¾ in. tables with a longitudinal traverse of 31 in. Cross and vertical movements on all machines are 11 in. and 16¾ in. Spindle and table drives are powered by independent motors, total horsepower of the Size 1D machines being 7½ and of the Size 2 machines 9½.

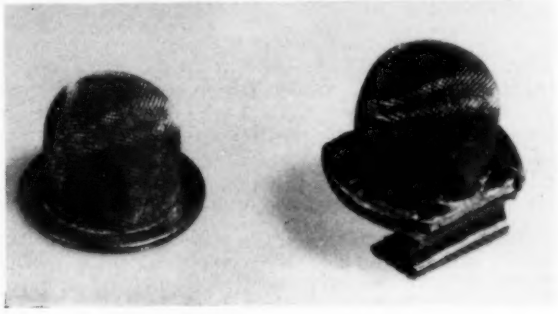
All models have eighteen spindle speeds ranging from 35 to 1800 rpm or from 56 to 2800 rpm, together with eighteen table feeds in each direction, longitudinal and cross ranges being 0·375 in. to 20 in. per min or 0·75 in. to 40 in. per min. Vertical feeds are 20% of these ranges. Rapid traverse in each direction is also provided, longitudinal and cross rate being 160 in. per min.

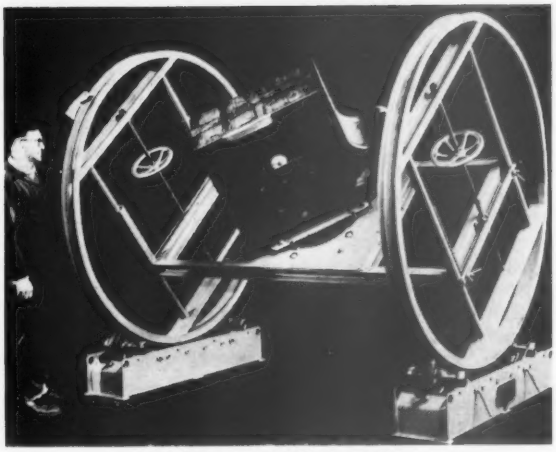
Automatic cutter relief, programme control, independently powered overarms with universal or vertical heads, vertical and universal milling heads, optical setting equipment, vertical and horizontal automatic indexing attachments with one or three spindles, precision dividing heads, hand and power operated circular tables and machine vices are among the optional equipment available.

No Contact Contamination in New Computer Relay

A low current version of an existing miniature high speed sealed relay has been developed with an activated carbon getter inside the container to absorb the slight organic vapours that remain after sealing which lead to contact contamination. It is particularly suitable in its special version for use as a "chopper" for converting low power d.c. signals into alternating voltages, as required for amplification in computers; and has application in other circuits where control of low currents in microamps is required. Of the single changeover type, the relay is made for various voltages between 1·2 and 48 volts d.c. Typically the contacts might be used to switch 25 millivolts at 1 microamp. These contacts are of platinum, and contact resistance is 0·1 ohm or less. At 100 operations per second the relay has a life of 300 hr minimum, though 5000–10,000 hr are usual; a recent continuous life test showed approximately 3600 million operations. Known as type 130, the relay has been developed by Siemens Edison Swan Limited, 155 Charing Cross Road, London WC2, and is basically similar to their existing miniature hermetically sealed design.

The new relay with cover removed and two examples of the carbon getter which absorbs organic vapours and thus prevents contamination of the contacts





Welding rotator adjustable in two planes

Fully Adjustable Balanced Welding Manipulator

A rotator to accommodate components for welding, of any shape and weighing up to 10 cwt and to revolve the component through 360° in two planes by hand operation has been introduced by Yates Plant Limited, Whidborne Street, London WC1.

It consists mainly of two idler rotators, two end rings and an adjustable platform in which is mounted the revolving table. The idler rotators are entirely separate from the manipulator and when not required for use with the manipulator they can be used as standard idler units with or without the Yates H.D. pipe rotator. They are designed on the patented "Autroset" principle and consist of a fabricated frame with one quickly adjustable rubber tyred roller at each end. The rotator can accommodate vessels from 2 in. to 6 ft dia.

For use when the rotators are being used with the manipulator, there is provided on each rotator a hand wheel operated friction brake which clamps on to the rubber tyred roller at one end only. This gives a braking effect to the manipulator when it is being loaded.

The end rings are fabricated from M.S. channel and the flanges locate the rings on the rotators and prevent endwise movement. Spaced across each ring there are two guide tubes for the table platform, and across the centre of each ring there is a handwheel-operated lead screw for adjusting the platform when balancing the component. The platform framework is made from channel and is cross braced. At each end there are two wing nuts which clamp the platform to the end rings after adjustment for height.

In the centre of the platform is a revolving table made from 1 in. thick mild steel plate. A feature of the table is the provision of a 21 in. dia hole in the centre through which the operator can gain access to the component for internal welds. The table revolves within four rollers, two of which are mounted on eccentric spindles to facilitate adjustment for slackness. Each side of the table there are six ball type castors mounted on mild steel cover plates.

Four machined pillars are provided on the table on which can be mounted the component or a special fixture to take the component. A handwheel-operated friction brake provides for locking the table.

Stiff Polythene Mesh

The range of mesh materials available to engineers and designers has been extended by the introduction of the first high density polyethylene mesh.

This new mesh, produced in roll or sheet form, similar to metal mesh, is made from Rigidex polyethylene supplied by British Resin Products. It has a very low specific gravity (0·96) and is thus only one third the weight of a corresponding aluminium mesh, and less than one eighth the weight of mild steel. In all thicknesses the mesh is flexible enough to be handled very easily, and in thicknesses above $\frac{1}{8}$ in. it is sufficiently stiff to be self-supporting.

The mesh has a comparatively high strength/weight ratio and is virtually indestructible. It is resistant to water, sea-water, practically all chemicals, and to most oils, greases and solvents. The inertness of the polyethylene from which it is made means that very few substances will adhere to it even temporarily, and the mesh is thus very easy to clean. In addition, the mesh is available in several colours which are inherent in the polyethylene, and it therefore requires no painting or finishing. It has outstanding electrical properties, the dielectric constant being 2·35 at 1 Mc/sec and the power factor less than 0·0001 at 1 Mc/sec. The mesh can be used at temperatures of up to 100°C without significant distortion and can thus be sterilized in boiling water if required.

Uses for the new mesh include guards for electric motors operating in corrosive conditions, battery separators, grilles and screens in chemical plants and laboratories, filtration supports, and interior decorative panels. It is made by the Expanded Metal Company Limited, Burwood House, Caxton Street, London SW1.

Standard range of Osborn Lazmet Diard grinding wheel dressers and hand lap

Diamond/Abrasive Dressing Tools

Lazmet Diard grinding wheel dressers and hand laps have an abrasive surface composed of an extremely hard matrix impregnated with small diamonds, and the matrix, in addition to providing an extremely firm bond for the diamonds, also acts as an abrasive. The tools will withstand a considerable amount of abuse and the distributors, Samuel Osborn & Co. Limited, Clyde

Steel Works, Sheffield, 3, state that the tools may be safely used by semi-skilled or unskilled operators. Tests indicate that their life is five times that of the older type of dresser.

The "Osborn" impregnated hand lap is very useful to machine operators using carbide tipped tools and has an abrasive surface of similar composition which eliminates grooving of the tool during use.

This Sinex parts feeder places diamonds under the magnifier for inspection and automatically ejects oversize stones

Mechanical Aid to Inspecting Styli Diamonds

An unusual application of a newly designed Sinex parts feeder is the feeding and timing of diamonds of gramophone styli automatically to a rotating glass disc provided with a groove for the diamonds, which presents them beneath the objective of a projector, a magnified image of the diamonds is then projected on to a calibrated screen.

Two control knobs seen in the photograph are conveniently placed for the inspector; one which stops the rotation of the disc where closer examination is required, and the other, a reject button, is connected to a compressed air supply from a miniature compressor fitted in the control box seen on the left of the photograph. The inspector, by pressing this knob, can release a jet of air through a hypodermic needle situated opposite the diamond under inspection, which expels it should it not conform to profile.

The parts feeder itself (shown in the foreground of the photograph) performs two important functions in addition to that of feeding diamonds. For convenient inspection the diamonds must be fed on to the rotating disc at suitable intervals determined by the distance which spaces them apart. This function is achieved by means of a microswitch fitted to the side of the bowl near the outlet which operates a knife, the top of which lies in a slot flush with the outlet flight. The knife acts as a gate and by means of an electronic timer (also contained in the control box) allows one diamond to pass at a time at intervals controlled by the timer.

The other function is the automatic rejection of overlengths. This is achieved by timing each diamond as it passes over the slot in which the knife rests. The acceptable length is translated into milliseconds on a second timer also fitted in the control box. Any overlengths are automatically rejected back into the bowl by the operation of the knife coming up through the slot.

The European member of the Sinex Group is the Sinex Engineering Company Limited, Central Way, North Feltham Trading Estate, Feltham, Middlesex.

Masking Tape Withstands 5000° F

The new high temperature masking tape "HITEM 577" is now being used for metal spraying processes. A recent process involved the metal build-up of a journal on a Perkins P.6 six cylinder crankshaft. It was necessary to mask out the webs and journals nearest to the area of operation and this was done with HITEM 577 crepe paper masking tape.

Before metal spraying, the crankshaft was shot-blasted with aluminium oxide grit. The surface of the journal was then ready to receive the preliminary build up and a bonding-coat of molybdenum was sprayed on at a temperature of 5000° F, then the final build-up operation was completed. High carbon stainless steel particles were sprayed on to the journal for several minutes.

On completion of the process the tape nearest to the area of operation had become metallized and came away quite cleanly leaving an undisturbed surface underneath. The rest of the tape was stripped off and no adhesive remained on the crankshaft. The tape had localized the area of operation and there was no extra work required in cleaning down the crankshaft after the masking material had been removed.

HITEM 577 is a new tape made by John Gosheron & Co. Limited, Albert Embankment, London, S.E.11.

Electro Brush Plating Ltd

Engine crankshaft being metal sprayed. Unsprayed parts are covered with a new heat resisting masking tape

Commercial Tolerances on Permanent Mould Castings

Ten years ago, the author published the first comprehensive system of calculating the required tolerances on diecastings. This was widely adopted by buyers of diecastings, especially in the U.S., and led directly to the drawing up of the A.D.C.I. Product Standards some years later. Now, after much study of the limits which are actually held in production on permanent mould castings, Mr. Barton has drafted a provisional system for assessing them at the design stage

By H. K. BARTON

IN many respects, permanent mould castings occupy a position intermediate between sand-castings and diecastings. This is true of their production, for the metal is poured from a ladle, like a sand-casting, but undergoes quick chilling in a metal mould much as a diecasting does. To a large extent it is true also of such characteristics as surface finish and dimensional accuracy, which also have typical quality levels lying between those for sand-castings and diecastings. In use, too, permanent mould castings frequently represent for the designer a "half-way house"; when a component is required in only small quantities it is sand-cast, and as the number needed increases it is converted first to permanent mould casting, or "gravity diecasting" as it is often termed in this country. When really large quantities are called for, a second conversion, to the diecasting process proper (called "pressure" diecasting when it is necessary to distinguish it from the "gravity" process) is quite frequently adopted.

Because of this, permanent mould casting often appears to be thought of as a poor relation of diecasting, whereas in point of fact it is a valuable production method with advantages all its own. Many conversions—mainly in the case of aluminium components—certainly do take place, but there are thousands of components in regular production by the permanent mould process which could not be more economically produced as diecastings whatever the quantity required. Components with intricate internal recesses requiring elaborate collapsible cores, for example, are almost always better produced by the less-mechanized permanent mould technique, merely because present-day diecasting machines are so expensive to operate that unless they work fast they cannot show a profit.

Of at least equal importance is the fact that permanent mould castings can be made in a whole range of alloys which, for one reason or another, are not well suited to diecasting. Copper-base alloys, for example, present an intractable problem to the jobbing diecaster; although a few specialized companies do in fact produce brass diecastings by the cold-chamber process, die life is short owing to the severity of the thermal stresses set up when the hot metal impinges upon the cool die. These stresses are not encountered to the same extent in permanent mould work, partly because metal enters the cavity more slowly, and the initial rate of heat exchange is accordingly less, but mainly because permanent moulds are given an insulating dressing on the cavity surfaces.

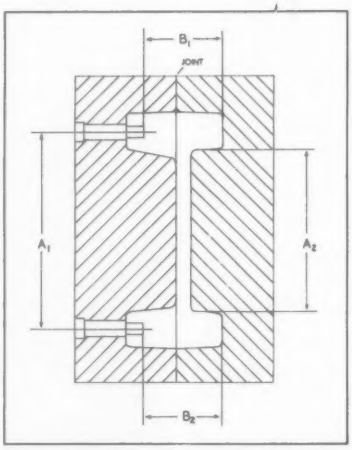


Fig. 1.—Dimensions on permanent mould castings fall into two fundamental groups: those between points in one portion of the mould only, A, and those B taken across the mould joint

In addition to the general-purpose 60/40 alloy (B.S. 1400 B.4.C) the stronger alloy with additions of aluminium and manganese (HTB.1.C) is sometimes used for permanent mould castings. This is especially so when the castings are to undergo fairly extensive machining, since this material has notable free-cutting

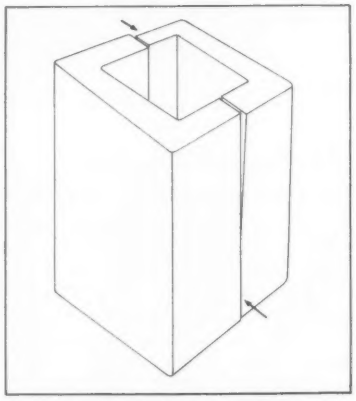


Fig. 2.—Misalignment of the two mould halves produces the effect here seen, greatly exaggerated. The inner faces, formed by a core, are free from the defect

characteristics. The brasses proper, however, are best suited to simple parts of not too thin sections, since they do not fill out fine detail and intricate ribbing so well as some of the other available alloys. Both the aluminium-silicon alloys, and the "aluminium bronze" group of alloys, are superior in this respect. The latter also have superior physical properties.

Aluminium bronzes contain about 10% aluminium and lesser proportions of manganese and nickle, and have an attractive as-cast colour—golden rather than brassy—which does not readily tarnish. Indeed, the good corrosion resistance of these

alloys, coupled with their high strength, renders them the most outstanding of the permanent mould alloys. The composition most usually employed conforms substantially to B.S. 1400 AB.1.C. and contains about 9% aluminium and 2% iron. Where the highest possible mechanical properties are required, the alloy with 5% each of iron and nickel is frequently specified: this conforms to composition AB.2.C of the B.S. 1400 alloys.

Many different aluminium alloys can be cast in permanent moulds, a large proportion of them being, on occasion, diecast and sand-cast as well. One of the most useful general-purpose alloys is B.S. 1490 LM.4., better known under its earlier designation "DTD 424". This has 2 to 4% copper and up to 6% silicon. It is a cheap, easily cast alloy of slightly less than average strength. The 10–13% silicon alloy, LM.6., has somewhat superior mechanical properties, is a very good casting alloy, filling out intricate sections and producing an homogeneous structure, and additionally has good corrosion resistance.

A notable aluminium permanent mould casting alloy is that containing 10% copper, which also has high corrosion resistance and is often adopted for marine applications. This alloy, LM.12., is now frequently used in its heat-treated condition; a Brinell hardness value of from 100 to 150 is then achievable. The ultimate tensile strength of permanent mould castings is in the region of 20 tons per square inch, one of the highest figures among cast aluminium alloys. The very highest strength in these alloys is found in the nickel-bearing group; LM.15., chill-cast and heat-treated, has yielded an u.t.s. of 21 tons per square inch. This alloy is, however, less frequently cast in permanent moulds than LM.14—"Y" alloy—which is heat-treatable, can be used at elevated temperatures (i.e. engine pistons, for example), and reaches 18 tons per square inch tensile.

Of the minor alloys which are, by preference, cast in permanent moulds, few are of importance from the viewpoint of the contract shop: the majority are the preserve of specialist users. Among these may be noted the low melting point alloys of lead, tin and antimony used for battery plates, founders' type, and similar applications. A remarkable sharpness of detail is obtained in many instances, but these alloys do not possess sufficient strength to warrant their use in wider fields. The zinc-base alloys, so well-adapted to diecasting, are in this country hardly ever cast in permanent moulds. Only the pressure diecasting process realizes to the full their inherent advantages; "gravity-cast" components lack the good finish, high tensile strength and close dimensional accuracy which characterize diecastings in these alloys.

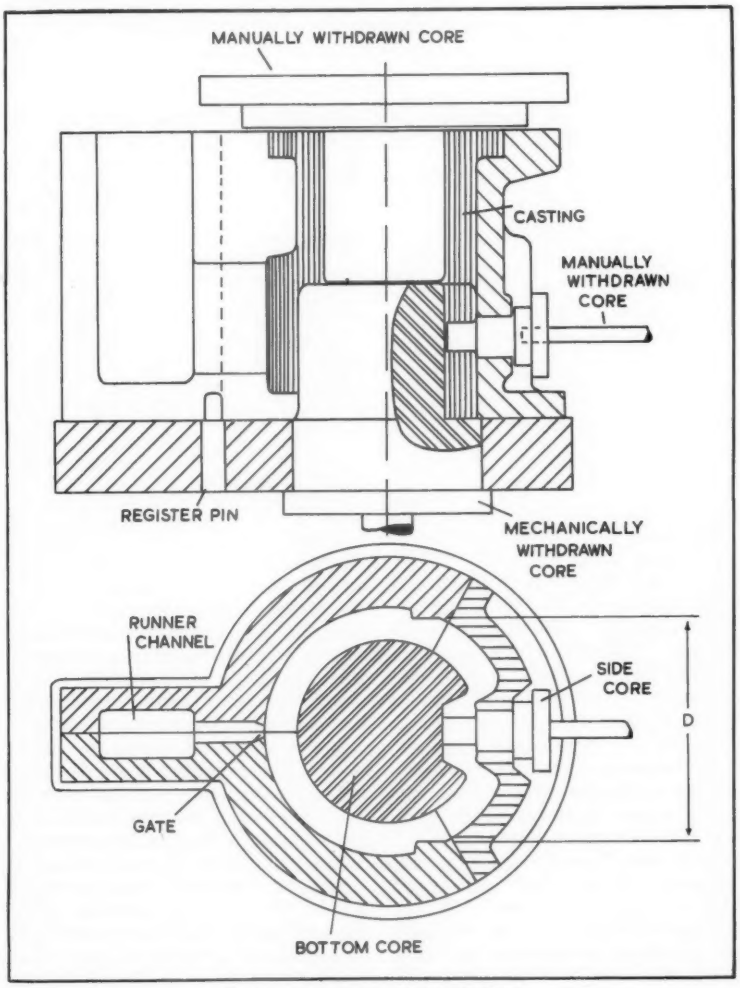


Fig. 3.—A three-part mould with radial joints

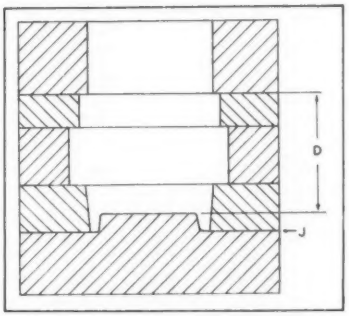


Fig. 4.—The dimension D must carry limits allowing for dimensional variation at all four joints, including that at J which affects the height of the central boss although below the datum face

A point of some interest is that, whereas the dimensional tolerances required on diecast components varies according to the alloy group adopted, zinc permitting closer limits than aluminium or magensium and these, in their turn, requiring smaller tolerances than the infrequently die-cast copper-base alloys, this factor is of very little importance where permanent mould castings are in question. By and large, castings of equivalent size and complexity can be produced to the same level of dimensional precision, whatever the

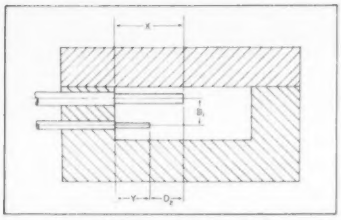


Fig. 5.—The variations to which D_1 and D_2 are subject differ appreciably, as shown in Table II

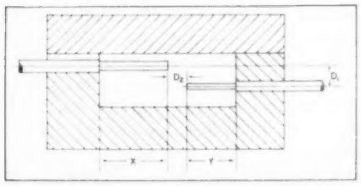


Fig. 6.—Opposed (or "anti-parallel") cores; dimension D_1 is affected by "core weave" and D_2 becomes less precise as the combined core length increases

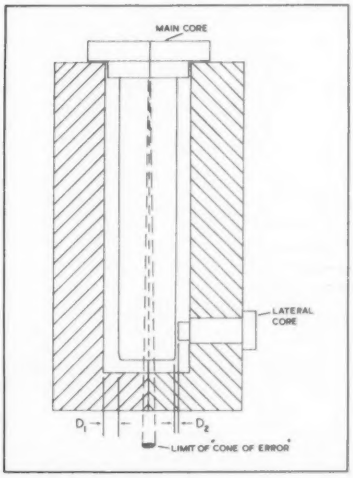


Fig. 7.—Long, unsupported cores may suffer considerable displacement; if two or more lateral cores can be placed to give support, the variation in D_1 is limited to the small clearance D_2

alloy from which they are cast. The overriding factor in determining the achievable precision is the simplicity, or complexity, of the mould required to produce the component.

In its simplest form, a permanent mould consists of only two separable elements, the cavity being formed either wholly in one of them or, more usually, partly in each as in Fig. 1. The two mould halves are held in register with each other by various means; stepped joints, dowels and bushes, seatings in a common base-plate or by hinging them together. Within each movable member there are often smaller fixed, but replaceable, elements—such are the small cores on the left of the figure. Because corrections can more

Table I.—RIGID CAVITY ELEMENTS

Location of datum faces between which the measurement is made	Limits	
	Basic	For each inch, add
	in.	in.
Two fixed points in one mould member (Fig. 1)	±0·010	±0·002
Two fixed points in opposite members (Fig. 1)	±0·016	±0·002
Two fixed points in die stack, for each intervening joint (Fig. 4)...	±0·016	±0·002
Two fixed points in die sectors taken between non-adjacent elements, minimum (Fig. 3)	±0·020	±0·002
Add for each 30° arc subtended by the chordal dimension, up to 180°	±0·002	

Table II.—MOVING CORES

Location of datum faces between which the measurement is made	Basic	For each inch, add
	in.	in.
Between a fixed point in one cavity member and another on:		
A point on a moving core housed in the same cavity member,		
Normal to core axis	±0·013	±0·002
Parallel to core axis	±0·015	±0·002
A point on a moving core housed in an adjacent cavity member,		
Normal to core axis	±0·020	0·0020
Parallel to core axis	±0·020	0·002
Between two moving cores, in same cavity member to axes ...	±0·025	±0·002
Core weave addition, $x + y$ (Fig. 5)		±0·001
Between two moving cores, in same cavity member		
Parallel to core axes	±0·030	
Addition for x—y (Fig. 5)		±0·002
Between two moving cores, anti-parallel to core axes, cores in same cavity member (Fig. 6)	±0·030	±0·002
As above, but cores in opposed cavity members (Fig. 8)	±0·036	±0·002

Table III.—WARPAGE, TWIST AND MISREGISTRATION

For each inch separating two correlated pairs of datum faces the possible variation between nominally identical dimensions should be set at	0·0015 in.

Table IV.— LOCATION OF SAND CORES

Location of datum faces between which the measurement is made	Limits
	in.
Between a datum on a sand core and one in the main mould, minimum	±0·020
For each inch of the longest dimension of the core print, add	±0·003

easily be made in case of dimensional error in the cavity, when one or both datum faces are formed by machined cores or other inserts, slightly closer limits can be held on dimensions such as A_1 in Fig. 1 than on A_2, taken between points in the solid block. This is only of practical importance, however, on dimensions of 8 in. or less; on longer dimensions the effects of die temperature variation, and variable contraction of the casting after removal from the mould, are predominant factors in determining the required tolerances.

The limits that can be held on dimensions like B_1 and B_2, which are taken between datum points in opposite mould halves, are necessarily less close than those achievable within a single mould member. Because of distortion, variations in the thickness of the mould coating, and metal debris lodging between the mould halves, the closeness of the joint between them can change between one casting and the next. The allowance for this variation is set at a level which will avoid too high a scrap rate from out of limit castings: 0·012 in. is generally acceptable to founders and this, added to the 0·020 in. required as a basic allowance for dimensions between any two points, yields plus or minus 0·016 in. as the closest limits that can be consistently held across the parting line irrespective of the length of the dimension. To allow for cumulative mould-making error, and variations in contraction which, of course, are proportionate to the distance involved, 0·004 in. (± 0·002 in.) is added for each inch of the dimension in question. These values are indicated in Table I.

A factor that is often almost as important as the actual holding of dimensions to certain limits is the manner in which variations from mean (or nominal) values occur. Thus in Fig. 1 the dimensions B_1 and B_2 are taken between exactly similar location faces, and if the mould members were evenly wedged apart, an increase in one would be associated with an equal increase in the other. In practice, however, this seldom occurs, and it is likely that the mould halves will be separated more on one side of the cavity than on the other, and that B_1 will be either greater or less than B_2. As will no doubt be clear from a study of the figure, this variation does not depend upon the actual value of either B_1 or B_2, but is a function of the distance between them: that is, in the

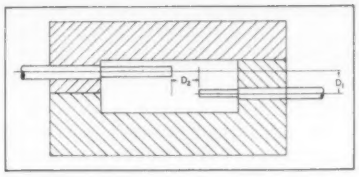


Fig. 8.—Opposed cores in different cavity members are subject to large and complex dimensional variations

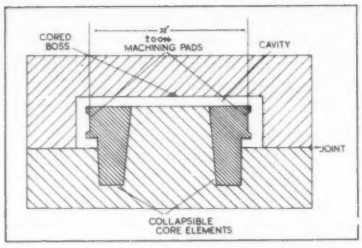


Fig. 9.—An indication of the limits required in large and complex moulds is here given; if the dimension is tied to a point in the other mould member (as for example the small cored boss), the possibility of lateral movement between the two main members makes it desirable to provide a machining allowance equal to the tolerance on each of the machining pads

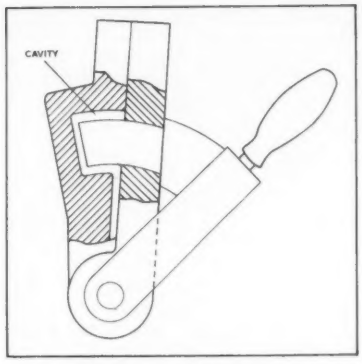


Fig. 10.—A hinged die in which the core is retracted along an arc and the casting brought out with it: further movement of the core strips it from the casting

example illustrated, the variation—or rather the *possible* variation—increases as A_1 increases. It will be evident that this factor affects many features of a permanent mould casting; for instance, variations in the thickness of the web of the casting from one point to another. It is applicable, too, to misregistration arising from other sources, such as the twist of the mould members in the direction of the arrows giving rise to the misalignment illustrated, with much exaggeration, in Fig. 2. The effect on limit is as shown in Table III.

Many permanent moulds have more than two main members; those for components of a generally circular form, but with much external detail, often consist of several elements withdrawing radially from a central core to release the casting. A simple example is depicted in Fig. 3, the tool consisting of a base-plate housing a large core which is withdrawn downwards by mechanical means, three cavity members surrounding the latter, and a top core of smaller size which is withdrawn vertically by hand. There is also a small lateral core housed in one of the cavity members. In a tool of this sort, the dimensional variations that can arise are more complex than in a simple two-part mould, and the limits set must take account of this.

In most such tools the cavity members are registered with reference to the base-plate in which the main core is housed; there are accordingly two sources of variation, the clearance of the core in its housing and the fit of the cavity members to their locations in the base-plate. Although both of these can, initially, be reduced to a value well below that associated with the junction between two cavity members, it is necessary when assessing commercial tolerances to take account of normal wear and tear, which result in cores and other elements becoming a slacker fit. This is allowed for in Table II, and although closer limits than these can in fact be held, the conditions under which this is possible vary from die to die. Only by discussion with the founder can the closest practicable limits for a specific component be established, and the specifying of limits closer than those in the table is almost certain to increase the cost of the casting.

The limits to be held between one cavity member and another, in tools which have several cavity members, are as in the first entry of Table I when the members in question are in direct abutment. If on the contrary they are separated by other mould elements, dimensions taken between them are subject to a number of distinct variations according to the number of joints interposed. In those cases where the mould elements are stacked to form the complete mould, the joints between them being more or less parallel to one another (Fig. 4) the effect upon limits is completely cumulative and the across-parting variation is multiplied by the number of joints. In the more usual cases where the elements are placed radially and the dimension in question is chordal as at D in Fig. 3, the limits are not strictly in proportion to the number of joints but vary with the angle subtended by the chord (which of course is assumed to take in at least two joints) as described in Table I.

The variation arising from the necessary clearance for withdrawable cores having an uninterrupted housing in a single mould member is given first in Table II, and this applies to dimensions taken from the core axis, or a face directly related thereto, across to a datum in the mould member which houses it. If the dimension is taken between the core and a point in a mould member other than the one housing it, the appropriate tolerance for the parting or partings between the mould members in question must be added in. The limits on dimensions taken between two withdrawable cores are double those for a single core and a fixed datum, with the same proviso as above regarding intervening joints.

The values referred to immediately above for dimensions between cores refer only to those taken normal to the core axes, or substantially so. If the dimension must be taken parallel to the core axis the variations encountered are both of a different character and somewhat larger; moreover, they vary with the length of the core, as shown in Fig. 5, when the cores are parallel. If the cores are anti-parallel as in Fig. 6, the limits that can be held vary with the combined lengths of the exposed cores between the datum faces and the respective mould members; that is, $x + y$ in the figure. It is also necessary to stress that dimensions between datum points of which one is on a core axis vary with the effective position along the axis of the reference point. This is equally so when two core axes are involved. Because of "core weave", which allows the axis of a moving core to take up any position within a cone (Fig. 7) the size of which depends upon the fit of the cores in it housing, the length of the housing, and the distance along the axis of the reference point, there is an indeterminancy in the position of one or both reference points which widens the limits. Whether the cores are parallel or anti-parallel, the allowance to cover this variation depends upon the combined distances $x + y$. Wider limits apply when the cores are housed in different mould members, as in Fig. 8.

Permanent moulds are quite often used together with sand cores instead

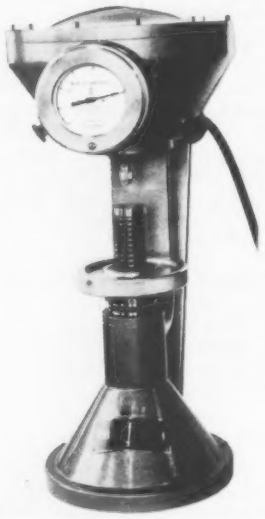
of steel cores, to which all the limits so far quoted refer. In present-day practice, the limits that can be held between point and point, on or in a sand core, are not significantly greater than those in one of the permanent mould elements—core or cavity member. The actual location of the core is nevertheless subject to somewhat larger variations; if carelessly placed the print may rub and the core not bed correctly. Further, of course, the finish on the surface formed by the sand does not reach quite the standard of the chill-cast faces. No dimension that can be thought of a critical ought to be established between a datum on the sand core and another in the steel mould, for the required tolerances are large (Table IV). Some producers request larger machining allowances on faces formed by sand cores, primarily to allow for misalignment of the core print rather than because the core itself is subject to dimensional error. Only on the smaller castings is this of primary importance; on the larger ones it is desirable to provide a generous allowance on machining pads, bosses and the like even if they are all formed in the steel mould. This is necessary because the limits of accuracy become progressively wider as the casting size increases and, for example, the limits on a dimension between two datum faces separated by 32 in. along a three-part collapsible core (Fig. 9) are $\pm$ 0·096 in. The machining allowance on the pads must be sufficient for this depth of cut to be taken at either end of the component. It is in every case better to determine the minimum machining allowance in this way than to set arbitrary values irrespective of the size or nature of the component.

The tables here given, taken alone or in combination, provide guidance to virtually every dimensional feature that is likely to arise in the design of permanent mould castings. No special mention has been made of arcuate cores (Fig. 10) since they seldom embody datum faces; the location of the core housing can, of course, be just as accurate as for a straight core.

Air-operated Brinell Tester

A new air-operated Olsen "Air-O-Brinell" which was recently introduced in the United States has been announced by Edward G. Herbert Limited, Atlas Works, Levenshulme, Manchester 19, who have been building a range of hydraulic Brinell hardness testing machines for many years, under licence of the Tinius Olsen Testing Machine Company, Philadelphia, U.S.A. This new machine combines the compactness and accuracy of hand-operated models with the operating ease of the motor driven types; the instrument can be used in the laboratory or on the production line.

Eliminating mechanical linkages, deadweights and hydraulics, the



Equally suitable for laboratory or production line, the new Olsen hardness tester has the compactness of a hand machine with the operating ease of the motor-driven type

principle of this new machine is that accurately regulated air pressure is applied by means of a heavy duty, long stroke diaphragm to the movable ram carrying a hardened steel ball which, in turn, applies the pre-selected Brinell load to the specimen. Upon closing the load valve the ram retracts automatically.

Under normal operating conditions only 1·2 cu ft of delivered air per minute at a minimum pressure of 65 psi is required to operate the tester. Since the amount of air accumulated in the head of the machine is accurately controlled by an air regulation valve, fluctuations in the air supply above 65 psi have no effect whatsoever on the operation or accuracy of the machine.

Load application is positively assured by reason of the air gauge indicating the load which will be applied before the test is made. Simple adjustment of the air regulator valve increases or decreases the air pressure in the machine until the desired load is indicated on the gauge and once the load is set, any number of tests can be made in rapid sequence.

The gauge is accurately calibrated for the standard range of Brinell loads of 500, 1000, 1500, 2000 and 3000 kg. The calibration of the machine may be checked at any time with a proving ring, test block, or other accepted means.

Electronic Batch Counter

A new Elcontrol batch counter speeds up to 10 counts per second is a compact self-contained unit housed in a small standard steel case. The lid is easily removable, being secured by two spring catches, and the chassis can be readily withdrawn giving access to the terminal block mounted in the case. Overall dimensions are $7\frac{1}{2}$ in. $\times$ $5\frac{3}{4}$ in. $\times$ 5 in. and the maximum count is 9999.

The counter is easily set up to the required batch number, the setting wheels being accessible when the cover of the unit is removed. The number is illuminated and is visible through a window. As counting proceeds, the counter displays a descending count, giving relay operation and re-setting at zero count. Input is photoelectric (using viewing head and light source or scanner), or by mechanically operated contacts.

The new instrument is made by Elcontrol Limited, Wilbury Way, Hitchin, Herts, and is designated BC2. It is designed to meet a large number of industrial production batch counting requirements and is additional to the original Dekatron (BC2) which has a higher speed range.

Heat-resistant Conveyor Belt

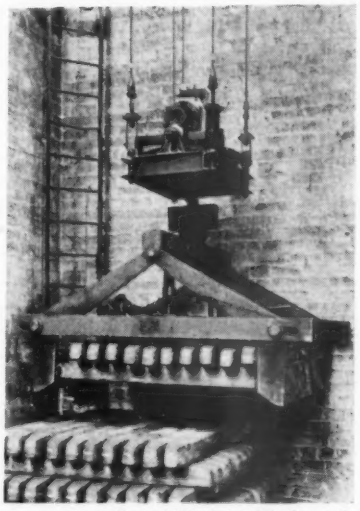
"Star-hete", a new synthetic rubber conveyor belt constructed to handle hot and abrasive materials, has been developed by Dunlop Rubber Company Limited (Belting Division) Speke, Liverpool, 24, for use in the iron and steel, chemical, cement, and gas industries. Star-hete has a cover of synthetic rubber which will withstand temperatures of up to 350°F and can be provided with a carcase weight of duck, and in ply ratings, to suit all conditions and loads.

Automatic Guidance for Lifting Tongs

The constant lifting of objects of regular shape is almost invariably done more efficiently and economically by special appliances than by slings, and specially designed tongs greatly facilitate crane working in this way. Two examples of improvements effected by this means come from Walter Somers (Materials Handling) Limited, of Halesowen.

The first concerns automatic tongs designed to handle barrels in the tobacco warehouses of Manchester Warehouses Limited, where due to Customs procedure, each barrel has to be handled four times. The objects were to increase stacking speed, obviate the necessity for having men on the stacks, and to make the fullest use of storage space beneath the cranes.

To secure accurate stacking, two wire cables were attached to the ends of the tongs and led up to self-reeling

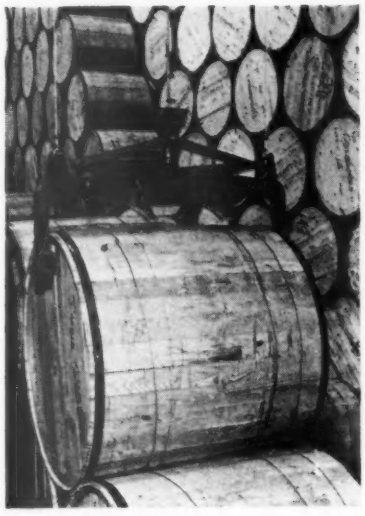


Port of Manchester Warehouses Ltd

Cask lowered precisely into position of stack—note narrow margin of clearance

drums mounted on either side of the travelling carriage of the cranes. This effectively controlled any tendency for the load to rotate about the axis of the crane rope. It was anticipated that, due to the high rates of acceleration and deceleration of the cranes on the long and cross travel, some trouble would be encountered with "pendulum swing" of the load, but in practice this was found to be negligible.

Another aspect of the problem was the need to reduce to a minimum the side clearance required for the insertion of the tongs between the ends of the packages in adjacent rows. By careful design and the use of alloy steel, it was found possible to produce a tong requiring a bare 4 in. end clearance, whilst retaining a generous safety factor when lifting



Richard Johnson & Nephew Ltd., Manchester

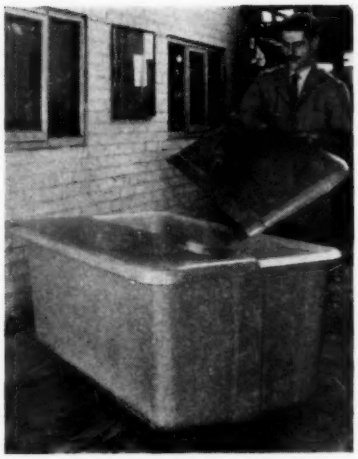
Double layer load lifts—all by control from crane cab

10 cwt casks. Special attention was given to the design of the steel jaws, which basically consist of rectangular plates in which are inserted many detachable studs, made from toughened steel and sharpened on the contact points. With these jaws it is possible to lift one 10 cwt cask or two 5 cwt cases at one time, in perfect safety and without in any way damaging the timber, plywood or hardboard from which they are constructed. Should it be found that with continual usage the studs become worn or blunted, they may readily be replaced in a few minutes.

A stacking height limited solely by crane clearance has been achieved, and with very little practice the crane drivers have been able to build orderly stacks up to 30 ft high, entirely without the assistance of slingers.

The second installation adaptation has been designed for the wireworks of Richard Johnson & Nephew Limited, in Manchester, to handle copper wire bar.

An important time and cost factor was involved; stock unloaded on the dock needed to be removed quickly as dock dues were chargeable.



GLASS FIBRE TRUCK AND TANK COVERS.—Having all the advantages of glass fibre construction the tank and truck covers, shown here in two halves, may also be had in one piece. They are self-coloured with good surface finish and are made by White, Child & Beney Limited, Shepley Works, Audenshaw, Manchester, to fit tank mouths of 36 in. × 24 in., 54 in. × 30 in., and 66 in. × 30 in.

The copper wire bar is stacked in 1½-ton layers with each layer at right angles to the next, and to avoid having manual attendance at ground level a turn-table device was designed which, built over the tongs and controlled by powered cable from the cab, would turn the tongs 90° either way. Pivoting was overcome by four wires attached one at each corner of the turning-gear frame, and controlled by self-winding reels attached to the travelling carriage of the crane.

A further refinement has been introduced by which the jaws of the tongs are built with a double lip, with a selector mechanism incorporated in the controls so that either a single or a double layer can be picked up at will.

Tar/Epoxy Protective Coating

A new coating to give protection against corrosion is a compound of coal tar and epoxy resin. Named "Epi-Tar" it gives a coating of up to 0·01 in. in a single brushed coat and will tolerate limited surface preparation. Protection is provided throughout a wide range of conditions and against many chemicals, and Epi-Tar is stated to cure under almost any weather conditions, even under water almost immediately after application. It is a two-pack material with a pot life of about five days after mixing. It is made by Corrosion Limited, Southampton, and sells at 68/6 per gallon.

technique

—devoted to the discussion of practical problems
Readers are invited to contribute items from their own experience in matters relating to design, manufacture and maintenance

Safety Gate on Armoured Conveyors

A safety device, which protects men working on conveyor mounted machines from being trapped by the conveyor chain or from being pulled underneath the coal cutter or power loader, has been designed and constructed by Mr. J. M. Lawson, manager; Mr. T. W. Allison, assistant manager; Mr. T. J. Benson, unit electrical engineer, and Mr. K. Lowe, coal cutter fitter, at Bickershaw Colliery.

The device at the same time serves as a protection against injuries caused by large pieces of rock or other material carried on the conveyor.

It can be used in connexion with any installation in which coal cutters are mounted on an armoured conveyor. It consists of a skid mounted safety gate which is hauled along the conveyor immediately behind the machine. The length of the skid is similar to that of a cable carrier. Attached to it is a bridge supported by lateral struts of sufficient strength to withstand the weight of falling top coal.

The bridge is the width of the armoured conveyor and is located at the end of the sledge about 8 ft from the rear of the machine. It is 28 in. high and from it is suspended a steel plate 16 in. long and 22 in. wide. The plate is attached to the bridge through a $\frac{3}{4}$ in. dia shaft which acts as a hinge. A cam plate is fitted to the shaft.

The effect of this arrangement is that when any material or object above 12 in. high is carried down the conveyor it strikes the steel plate which swings forward and rotates the shaft on which it is hinged. This shaft rotation turns the cam which is designed to operate a B.S.A. limit switch mounted on the skid. An electric circuit between this switch and the pilot circuit of the armoured conveyor is so arranged that operation of the switch stops the conveyor. In practice, fouling of the gate device halts the conveyor almost instantaneously. The conveyor cannot be re-started inadvertently by the plate dropping back into position. The conveyor remains stopped until the plate is rotated through 180° and then dropped back into the normal operating position.

The limit switch is connected into the pilot circuit in the following way. The pilot circuit is carried along the coal face in conductor wires within wire ropes which are specially made to give adequate protection against rough usage.

The rope is made up of ten-yard lengths connected by Victor face signal connectors. In the centre of the face a T-piece is put into one of the connectors and a 75-yd cable connects the limit switch on the safety gate to this T-piece; thus the safety device is kept in circuit continuously.

Automatic Centreless Grinding of Ball Pins

For the automatic grinding of ball pins similar to the normal type shown in Fig. 1, an interesting automatic equipment has been designed by Arthur Scrivener Ltd, Tyburn Road, Birmingham, in connexion with their No. 2 controlled-cycle centreless grinding machine, which includes a couple of items of more than ordinary interest.

The piece is ground simultaneously on the radiussed head and tapered portion of the shank, and the loading of the piece between the wheels is effected by swing-over transfer fingers which pick up and transfer the work in much the same way as a human hand and forearm (Fig. 2). The rotary table is first loaded with a full charge of 32 pieces, and at the commencement of the cycle the transfer fingers swing back and close upon the piece which is in alignment with the grinding throat of the machine, swing over to lay it on the workplate between the wheels, and release it as soon as it is in position. The controlled-cycle mechanism of the machine then comes into operation to advance the control wheel and piece against the grinding wheel, maintaining it in position until it is ground, after which the control wheel recedes and the fingers of the transfer mechanism close on the small end of the ground piece, swinging this back to replace it on its former position on the rotary table and release it. As soon as the piece is released, the table (the move-

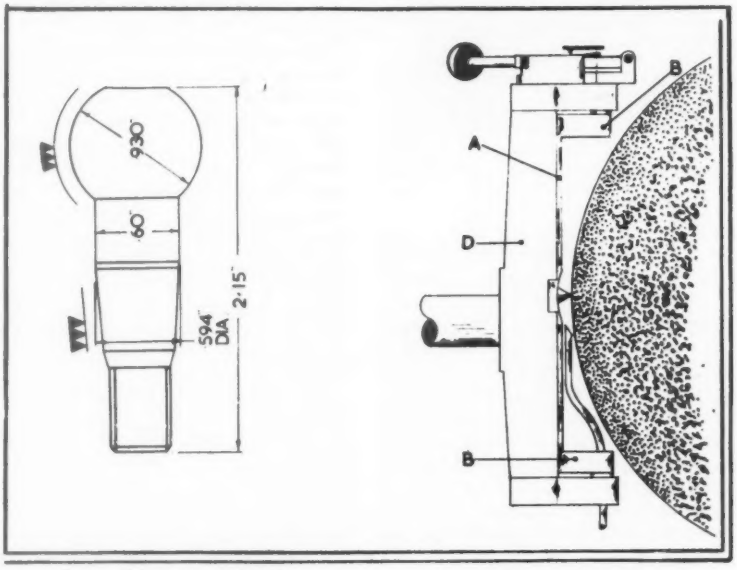


Fig. 1.—Outline of typical ball pin

Fig. 4.—Radius-truing attachment

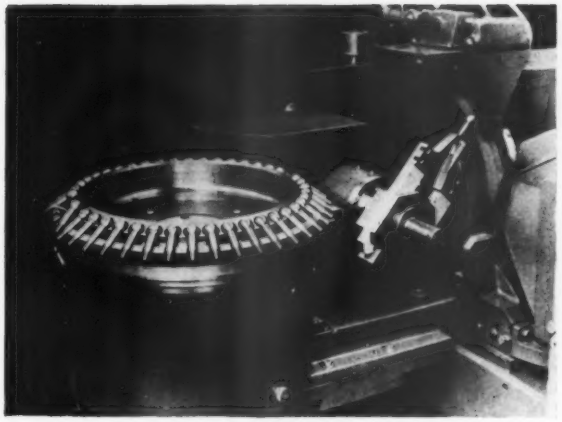


Fig. 2.—Rotary table and swing-over transfer fingers

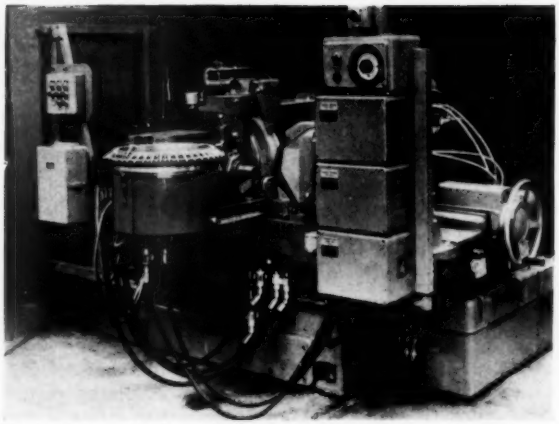


Fig. 3.—Scrivener No. 2 controlled-cycle centreless with fully automatic equipment for grinding ball pins

ment of which is synchronised with the controlled-cycle mechanism of the machine) indexes forward one station, and the cycle recommences. The table indexes clockwise, and the ground piece is ejected into a chute as soon as it reaches the removal hook which can be seen at the rear of the table. With a stock removal of some 0·008 in., the production of the machine is approximately 240 per hr.

Truing of the radius on the grinding wheel for form-grinding the ball end of the piece is an important factor in ensuring finish and accuracy. The radius-truing attachment for this can be seen on the left-hand side of the machine (Fig. 3), and its operation can be followed on reference to the line drawing (Fig. 4). It will be seen from the latter that it consists in essentials of a C-shaped diamond carrier A with trunnions B at each end. The surface of this carrier when viewed in plan is semi-circular, and it is thus substantially supported by the similar concave surface of the exterior base or support D with top and bottom bearings in which it is mounted. By means of the handle and adjustable gate shown, the diamond holder is movable through 180°.

The device is mounted on the barrel of the normal form-truing attachment, by which arrangement the grinding wheel can be trued to any desired taper or form from the usual former plate until in its traverse across the wheel the diamond reaches a predetermined stop, at which point the traverse of the truing slide can be arrested, and the required radius or arc then generated by the movement of the hand lever controlling the radius-truing device. In this way, when it is necessary, it is possible to generate a true arc as an emergence or a continuation of the form which has already been dressed on the grinding wheel from the former plate. Another feature of the device is that no breakdown in the set-up and no opening-up of the wheels is necessary in order to put it into operation.

On the control-wheel side of the machine, this wheel also requires dressing with a somewhat similar radius, but being of a much smaller arc this latter can be dressed on the wheel from a former plate, as the control wheel merely serves to support the piece and does not require to envelope it in the same way as the grinding wheel.

Cooling Briquettes with Sand

Scientists at the Board's Coal Research Establishment at Stoke Orchard have devised a means of controlled cooling of briquettes in the absence of air, using sand or similar material as a cooling medium. The method is also suitable for the controlled cooling of coke and other solid material in lump form.

The purpose of the new technique is to overcome the disadvantages inherent in the use of liquids or gases as a cooling medium. These disadvantages are that gaseous cooling media have a low volumetric specific heat, and may react chemically with the material being cooled, particularly at high temperatures; liquid cooling media can be used for controlled cooling only at temperatures below their boiling point and may react chemically with the material being cooled or suffer from thermal decomposition.

In the Stoke Orchard system the briquettes to be cooled are charged into an airtight vessel where they form a bed resting on an inclined grid. The cooling medium—30 mesh silica sand—is allowed to flow from a bunker through a flow control valve on to a distributor which spreads the sand uniformly over the bed. The sand trickles through the voids in the bed, removing heat at a rate which depends on the rate of flow and the difference in temperature between the sand and briquettes.

After passing through the bed of briquettes, the sand carrying the heat away passes through the grid at the bottom of the airtight vessel into a standpipe. The hot sand is then transferred from the standpipe, by an air supply, into a pneumatic transport main, in which the air takes the heat from the sand. The sand is separated from the air and returned by gravity to the sand bunker. The temperature of the sand returned to the bunker is controlled by the volume of air supply. The hot air may be used for such purposes as drying or combustion.

When the briquettes have been cooled sufficiently the flow of sand is stopped by closing the control valve, and the briquettes are removed through a door at the bottom of the container.

It is possible by modifying the equipment to arrange for the cooling process to be a continuous one, and an inert or reactive atmosphere may be provided in the cooling chamber by admitting suitable gases.

The BICERA Blade-type Blower

A new blower for low pressure oil-free air

A BLADE-TYPE blower working on an entirely new principle has been evolved by the British Internal Combustion Engine Research Association from a study of compression processes and the realization of the need for a better but not more expensive machine than the Roots-type blower. When the new and attractive compression cycle was discovered it was developed in its most elementary form so that in addition to being a prototype test machine it also bore a close resemblance to the possible future commercial machine built to a limited cost. A wide range of design variables exists and the machine described here is not the only form in which the principle can be applied.

The object of the design was to obtain continuous inlet and delivery processes at constant velocity and an efficient compression process. In the interest of low cost and reliability it was thought necessary to break away from the normal two-rotor type of machine which requires accurate phasing and an attendant expensive gear train.

Operating cycle

The intake, compression and delivery processes take place in an annular channel formed in a rotor. At all times this channel is divided at two points 1 and 2, as shown in Fig. 1, the division 1 being a local constriction of the channel and the other 2 a thin blade which can turn on its own stationary axis. When positioned across the channel, this blade forms a blockage so that the revolving of the constriction acts like a piston causing an increase in channel volume on the one side and a decrease on the other which give intake and delivery through ports in the walls of the channel. Before the revolving piston reaches the blade, the latter is turned through 90° so that it is capable of passing through a narrow slot in the piston as it passes over the blade. A sequence of blades gives continuous seals both in the piston and as partitions dividing the channel, as shown in Fig. 2.

During rotation of the one blade relative to the next, the space between them varies, and this feature may be used to obtain internal compression, also shown in Fig. 2. Fresh charge taken in at a is trapped as volume b and then, by keeping this space sealed by making the channel converge, the air can be compressed down to volume c before this becomes part of the delivery space d.

The design was, however, modified as shown in Fig. 3 in order to reduce the production costs. In this design alternate blades have been replaced by stationary spacing pieces f which maintain the seal in slot e. Space b is now so large and is so shaped that its volume does not change rapidly with blade tilt and so compression takes place by back flow. This is no great loss for low-pressure machines, as the back-flow compression takes place in the stationary enclosed space b and imposes no torque load on the working mechanism. The process is therefore more efficient than the back-flow compression that occurs in Roots-type blowers, which heavily loads the approaching lobe.

Mechanical constriction

It is a fortunate property of the geometrical arrangement that, with the blades turning in the same direction as the rotor and at half its speed, they always point to the centre of the slot e. In this way they feed themselves through the narrowest possible slot. The minimum width of slot is determined not by the geometry of the process but by the thickness of the blades at the hub, which has to be sufficiently strong to take the air loading over the full area of the blade without causing a deflexion at the tip greater than the clearance permissible when the blade passes through the slot. On small machines the blades are over-hung from their supporting shafts, but on larger machines it would be possible to insert bearings at the remote ends of the blades, thereby permitting a greater ratio of blade length to diameter to be used.

The blades are mounted on shafts which rotate in a back plate which also supports the blade spacing pieces as shown in Fig. 4. A gear train giving a 2:1 reduction in speed, as shown in Fig. 5, drives the blades and keeps them in phase with the rotor which is driven directly by the main shaft. This shaft transmits all the power required for the compression process, leaving the blades free to

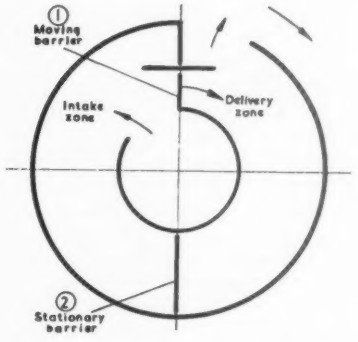


Fig. 1.—Descriptive diagram of mode of operation

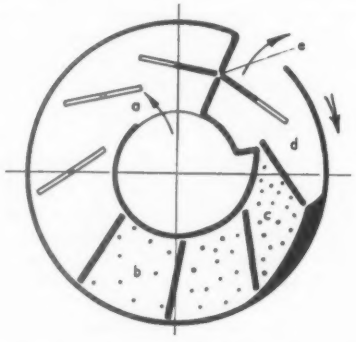


Fig. 2.—Modified form giving internal compression

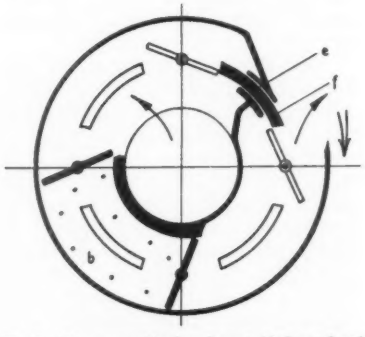


Fig. 3.—Arrangement having alternate blades replaced by stationary spacing pieces

Fig. 4.—Machine partly assembled showing blades, spacing pieces and inside of rotor

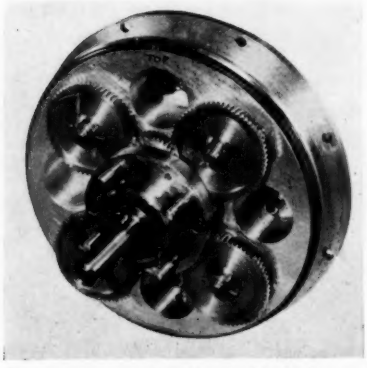


Fig. 5.—Back view of machine showing phasing gears

rotate without doing work on the air.

Design considerations

Air sealing.—Air leakage is one of the three most important sources of loss of efficiency in rotary machines, and machining to fine clearances one of the greatest sources of expense. The object has been to reduce the fine clearance surfaces to the simplest possible shapes and to make the clearances as far as possible independent of the accuracy of the phasing of the blades. The sealing faces between the rotor and casing require only simple turning, as do the faces of slot e and of the spacers f in Fig. 3. The slot e is of such a length that it spans the gaps between the spacers and the hubs of the blades. With these hubs having a diameter equal to the width of the slot in the rotor, the blades have a degree of freedom to rock on their own axes as the slot passes over them without the seal being broken or the tips fouling.

The seal made by the blades on the opposite side of the channel, that is where it is at its widest, is also made between arcs of circles. The tips of the blades are radiused so that again the blade has a certain degree of freedom to rock on its own axis without altering the tip clearance. The only surfaces of the channel that need accurate machining are the slot e and the walls enclosing the space b. The remainder of the channel is best designed to leave an adequate air space around the blades, and in practice the shape is usually settled by the dictates of simplicity of machining and the requirements of balancing.

Port areas.—The second important source of loss in air compressing machines is the air flow throttling losses. To a large extent, these determine the operating speed, which in turn not only determines the size of machine required for a given purpose but also has a direct influence on its efficiency, since raising the speed increases the throughput without increasing the leakage.

It has been found possible with this type of blower to have ports approximately equal in area to the cross section of the channel at b so that the air speeds are comparable with the rotor velocity at the mean channel diameter. With the air passing through constant areas of port and channel, there is little throttling loss. In fact this process is comparable to a normal piston compressor with both the inlet and delivery ports equal in area to the whole of the cylinder head. In addition the flow is assisted by taking the air into the centre of the rotor and passing it radially outward, as the natural centrifugal effect of the spinning rotor tends to throw the air in this direction.

Friction losses.—The third important loss to be considered is the friction of the mechanism. The parts carrying out the compression process do not need lubrication, so the only friction losses are those of the bearings and gears. The single rotor runs on two ball bearings and its shaft transmits all the compression power. The four blades also run on ball bearings and, as they run at only one half rotor speed, the frictional losses are low. The gear-train loading comprises only these bearing friction losses and so gives only a very small power loss. The light loading coupled to the fact that phasing accuracy does not have to be of the first order means that a light and relatively inexpensive gear train may be used.

Swept volume.—The approximate swept volume of this type of machine is given by the blade flat surface area minus its thickness area times the blade pitch circle circumference. For an accurate figure, a small allowance has to be made for the tilt of the blades on either side of the trapped volume.

Prototype test machine

The specification of this machine was:

Swept volume,	ft^3/rev.	0·0555
Max. operating speed,	rpm	4500
Max. delivery pressure,	psig	5
Blade size,	in.	3×2·5 dia.×0·45
Pitch circle diameter	in.	5·2575
Casing overall size,	in.	9·25 dia.×8·65
Weight of test machine,	lb	about 40

Fig. 7 shows the set of machined parts before the assembly of the first machine, and the back row, from left to right, shows the gear cover, back-plate, rotor, and delivery air casing. At the left front are the four blades, and at the right front their bearing mounts, whilst in the centre is the main shaft with its bearing mount, with the gears in the foreground. The rotor was cast aluminium alloy and designed to be in dynamic balance. Originally this was overhung from the main shaft, but a better performance has been obtained by supporting it at its outer end in a large diameter ball race mounted in the delivery air casing. At the same time the blade design was also modified and Figs. 4 and 6 show these modifications together with the mounting brackets for fitting the blower to an engine.

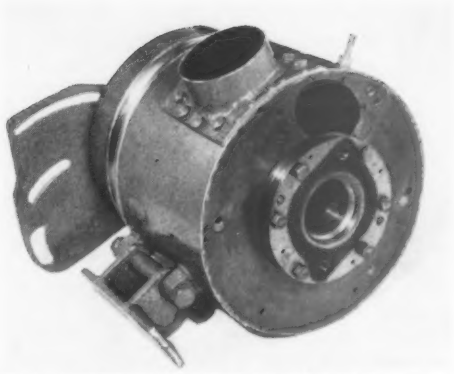


Fig. 6.—Complete machine, showing brackets for engine mounting and blanked-off alternative port position

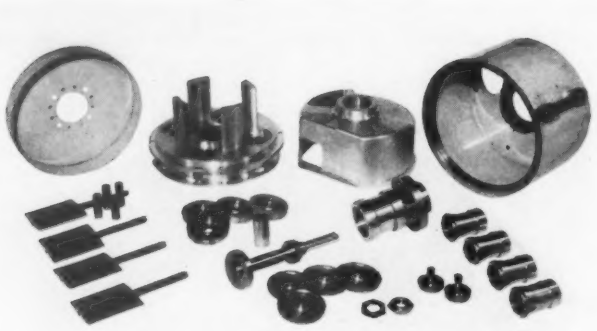


Fig. 7.—Machine dismantled showing component parts. (Mark I rotor with inward flow)

The blades, integral with their shafts, were machined from steel strip and the gear train comprised a steel pinion, bronze idlers and cast-iron blade gears. The steel pinion should be, but was not, hardened as in this case it was desired to accelerate gear wear to demonstrate that backlash of $\pm$ 1° on the main shaft could be accepted by the mechanism. The large gears dip into an oil bath for lubrication. The bearings closest to the air space are of the grease-packed neoprene-sealed type to act as a barrier between the oil in the gear case and the air.

Operating speed and pressure.—The experimental blade-type blower was designed as an engine pressure charger for relatively low pressures, the first target being 5 psig at 4500 rpm. This gave a rotor having a rim velocity of 160 ft/sec and a mid-channel velocity of about 100 ft/sec. So the air velocities in the ports were of the order of 100 ft/sec, which is lower than that commonly used in engine manifolds. For tests, the blower was mounted on a swinging bed dynamometer for power input measurement and was coupled to a large meter of the air-box type for air flow measurement.

Performance tests were carried out up to the design condition of 5 psig at 4500 rpm, and the results are shown in Fig. 8. The useful range of running conditions at 55 to 60% efficiency compares favourably with that of any other type of machine of comparable throughput, whether blower or compressor. The efficiencies based on air temperatures were higher than the overall figures as they profited by the heat losses during compression and delivery. The heat losses are large and the temperature differences very small at low speeds and delivery pressures, and the figures have little significance under these conditions. However, at the higher outputs the figures are of value and at 3 psig and more the temperature efficiency figures average seven units higher than the overall values.

After testing this machine on an engine, it was found desirable to extend the working range to 5000 rpm and 6 psig delivery pressure to match an engine speed range of 3:1. To achieve this the rotor rim clearances were increased, and this reduced the efficiencies by about three units from those shown in Fig. 8. In this latter form the blower has been used for 65 hr of engine testing. Its use resulted in a 20% increase in engine torque with very little increase in the minimum specific fuel consumption.

Noise.—This type of blower is not particularly noisy and, in fact, at low speeds and pressures it is very quiet. Only when engine speeds were above that which gave 4150 rpm at the blower and 4·5 psig pressure, did the blower noise noticeably exceed the engine noise. A simple inlet silencer reduced the noise below engine level up to the maximum speed of 2200 engine rpm. The principal source of noise is the expansion of the small pockets of air on either side of the blade tips, which are carried through the slot in the rotor from the delivery to the inlet space. The small pockets of air expand rapidly in the inlet space, creating noise and tending to excite the natural frequency of the inlet duct.

Applications.—Whilst the experimental blower was made specifically for low-pressure charging of a four-stroke-cycle engine, this type of machine is eminently suitable for supplying the scavenge air for two-stroke-cycle engines. The outer casing is, in effect, a built-in delivery capacity chamber which gives the advantages of damping out pressure fluctuations and permitting a wide choice of delivery duct positions. So although this blower is fatter than the bare Roots-type machine, in most cases the latter has to be fitted with inlet and delivery ducts which destroy its slim silhouette and make the sizes and shapes of the two machines more comparable.

The basic principle of this compression cycle can be used for any size of machine. However, as with all rotary blowers having clearances around the working parts, it would be expected that the efficiency would fall rapidly for sizes under 50 cu ft/min. Very small units could be made for pumping liquids, and it is thought that this principle could be used for a very efficient oil or fuel pump. The cycle gives steady flow free from fluid trapping, and the flow is assisted by a small centrifugal head.

For larger sizes of machine, say over 500 cu ft/min, it may well prove economic to use a more complicated mechanism in order to reduce the overall bulk per unit of swept volume and to assist fabricated construction methods. The machine would then be simpler to produce in small numbers than the Roots-type or others which require complicated rotor and casing castings. This form of design would have a rotor giving two air cycles per revolution, as shown diagrammatically in Fig. 9, and this leads to a rotor which is in natural dynamic and pressure balance. A greater number of blades would be necessary and these would be thicker in relation to their diameter. This facilitates the fitting of bearings at the outer ends of the

blades, a ring supported by the spacing pieces being used to mount these bearings. By the use of this extra support, a greater blade length-to-diameter ratio could be used. In this design the blades would turn at the same speed as the rotor.

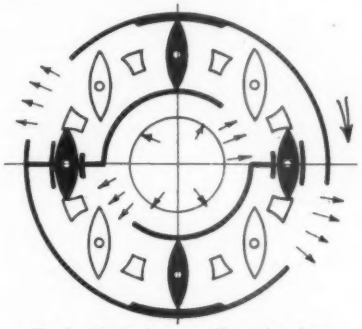


Fig. 9.—Two-cycle rotor with spacing pieces

In another possible variation of the single-cycle design the use of parallel-sided blades offers the possibility of reducing noise at the cost of a gear train giving a high degree of phase accuracy.

New High Strength Stainless Steels

Two new 60 ton tensile stainless steels especially suitable for steam turbine blading and for rotor and stator blading in gas turbine compressors have been developed by Firth-Vickers Stainless Steels Limited and are now in production.

The steels, FV.566 and FV.520, have chromium contents in the range 11—16% and are distinguished from the older martensitic stainless steels by lower carbon (0·03—0·12%) and higher nickel contents (2%—6%). Moreover, they carry other alloy additions, 1·5% molybdenum together with vanadium or copper, and niobium.

Compared with earlier steels of this type, they offer better corrosion resistance with higher yields and tensile strengths; formerly, specifying higher strength frequently meant somewhat reduced corrosion resistance. They also offer better cross grain ductility, superior impact strength and greater consistency from batch to batch.

The difference in properties between the two steels is mainly one of degree. FV.520, which is the more highly alloyed of the two, will withstand more arduous service conditions, having exceptional corrosion resistance equivalent to that of the softer austenitic 18/8 steel. FV.520 is weldable and its impact strength suffers no impairment at temperatures as low as minus 80° C.

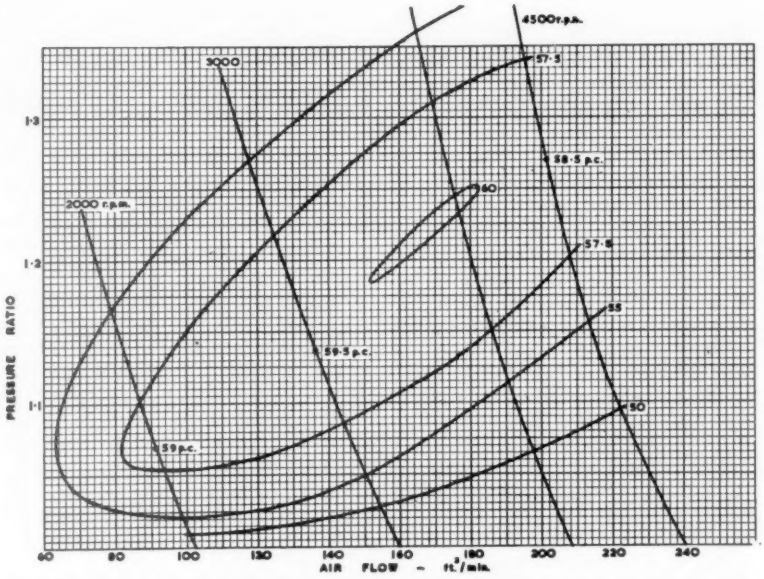


Fig. 8.—Relationship between overall adiabatic efficiency, rotor speed, pressure ratio and air flow for outward-flow rotor with front bearing

Advantage is being taken of these steels in connection with the increase in size of steam turbines that is helping to lower the cost of producing electricity. In 1945, few turbo-generating sets were bigger than 30 MW; today, sets of 275 MW and over are under construction in this country and up to 500 MW in America.

In the 275 MW steam turbine set produced by the English Electric Company Limited, at Rugby, 36 in. long forged low pressure turbine blades are being used. These are the largest blades used so far for sets of this capacity running at 3,000 rpm and some 360 blades of this unusual size are needed for each turbine. The blade tip diameter of the complete wheel is over 11 ft. To ensure safety in such highly stressed moving components, the materials used for the blades had to have a combination of high yield and fatigue strength with optimum ductility and impact strength particularly in the transverse direction of forging. As the large blades operate in low temperature wet steam containing water droplets, a stainless material was essential in order to attain high resistance to corrosion-fatigue and erosion. After exhaustive testing of full scale blades, FV.520 and FV.566 were two of the steels chosen for this duty.

Stainless steels are also used for gas turbine compressor blading. The Centrax C.T.7., a 430 shaft hp gas turbine produced by Centrax Limited of Newton Abbot, has blades machined from bar material. The blade tip diameter in this case is less than 12 in. FV.520 was chosen for both compressor rotor and stator blading because of its mechanical properties and corrosion resistance in salt-laden atmospheres.

Another example of the use of FV.520 compressor blading is in the Bristol Proteus engines used to power the prototype high speed naval launch H.M.S. *Brave Borderer* which recently achieved a record speed of over 50 knots during trials in the Channel.

Hand Tachometer

A fifth hand tachometer has been added to the range made by Smiths Industrial Division, Chronos Works, North Circular Road, London, NW2. The new instrument, the ATH.24, is for use with machinery in a speed range of up to 4,000 rpm, and has dial calibrations of 0-400, 0-2000 and 0-4000. Rotational or surface speeds are indicated to an accuracy of $\pm\frac{1}{2}$%, indication is instantaneous and there is a device for locking the pointer. The instrument is not affected by position, humidity, or wide temperature range, and is supplied in a case with a set of centres.

British Proposals for Nuclear Marine Propulsion

By J. R. FINNIECOME, M.Eng., M.I.C.E., M.I.Mech.E., F.Inst.F.,
Consulting Engineer

IN this age of rapid technical advance it is already difficult to trace the progress in the researches and developments in nuclear engineering. In this field, nuclear marine propulsion has received world-wide attention during recent years and certain noteworthy achievements have been surveyed in a previous contribution. Although progress in Europe has been relatively slow compared with the remarkable advances made in America, nevertheless there is ample justification for directing attention to certain design features and advanced researches which have been in progress for some years, and considering some of the more recent developments. The U.S.S.R., up to the present, is the first country in Europe and the second in the world to have completed and commissioned a nuclear-powered vessel, which is to receive further consideration later.

The progress of research and development in nuclear marine propulsion in Great Britain is given chronologically below:

1950.—The A.E.R.E. at Harwell began to take a casual interest in a project for a nuclear submarine. The reactor selected was of the graphite-moderated gas-cooled type, for at that time this reactor was receiving special attention. In July of that year the first reactor was started up at Windscale, Cumberland. It had natural uranium as fuel and was graphite-moderated and air-cooled.

1950 (July 21).—A copy of a drawing showing a possible arrangement for the atomic propulsion of a submarine was published in this journal on July 21, 1950, and is reproduced in Fig. 1.

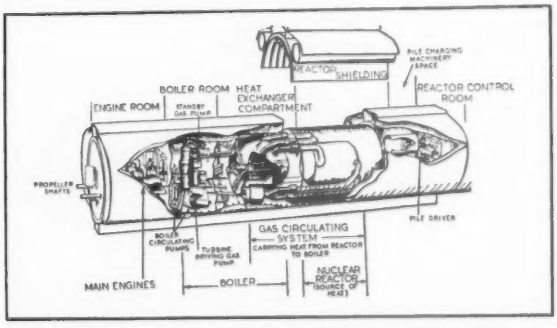


Fig. 1.—Possible arrangement for nuclear propulsion of a submarine

1955.—Joint Nuclear Marine Propulsion Panel set up, consisting of:
(a) Institution of Marine Engineers,
(b) Institution of Naval Architects,
(c) North-East Coast Institution of Engineers and Shipbuilders,
(d) Institution of Engineers and Shipbuilders in Scotland.

1956 (February 23).—A special group, Vickers Nuclear Engineering Limited, was formed to consider nuclear energy for marine propulsion. The group consisted of:
(a) Vickers Limited,
(b) Rolls-Royce Limited
(c) Foster Wheeler Limited.
The Admiralty decided to apply nuclear power, in the first instance, to a submarine, H.M.S. "Dreadnought", and to install a light water moderated and cooled reactor, as used in America for a nuclear-powered vessel. Unfortunately, such a reactor had not been built in Britain nor was there available much design information or operational experience. Consequently it was considered advisable to build first of all the experimental submarine reactor "Neptune", to be installed at Harwell, and also a land-based power reactor at Dounreay, Caithness. The details of the specification for the "Neptune" received first consideration. It was most important that the completion of the project and the experimental programme had to be accomplished in record time.

1956 (July).—The design of the Admiralty's zero energy submarine reactor "Neptune" was commenced by Rolls-Royce Limited, who as a member of Vickers Nuclear Engineering Limited, was employed by the Admiralty as the main contractors for the design and the construction of the reactor.

1957 (November 7).—The "Neptune" went critical only 16 months from commencement of design. It was the 11th experimental reactor to be started up at Harwell. The others are Gleep, Bepo, Zephyr, Dimble, Zeus, Zetr, Lido, Dido, Nero and Pluto.

1958 (January 28).—Anglo-American discussion on nuclear marine propulsion. Rear Admiral Hyman G. Rickover of the U.S. Navy and his companions, Rear Admiral Morgan of the U.S.N. and Mr. Mandell of the U.S. Atomic Energy Commission, visited Britain for four days.

1958 (March).—A Government statement revealed that Great Britain's first nuclear-powered submarine, "Dreadnought", may be in commission by 1964, nine years after the U.S. "Nautilus".

1958 (June 15).—The Admiralty agreed tentatively to buy a nuclear submarine power plant from the Westinghouse Electric Corporation, at a cost of about 25m dollars (£9m). This was sanctioned by the U.S. Government. Great Britain had been spending about £2·5m a year on nuclear submarine development and research.

1959 (January 2).—The Admiralty announced that a floating dock was to be specially built for the construction of the nuclear-powered submarine "Dreadnought". It was to be known as AFD59 and the keel was laid on January 2, 1959 in the Naval Dockyard at Portsmouth. It would be used at Vickers-Armstrongs' Yard at Barrow-in-Furness during the construction of

the hull of "Dreadnought" and provide repair facilities for the "Dreadnought" and other ships. The dimensions of this floating dock were so arranged that destroyers and frigates could also be accommodated. The "Dreadnought" was not designed to carry missiles.

1959 (March 9).—The United States authorized the transfer of a complete submarine nuclear power plant to Great Britain, to be installed in the "Dreadnought" and to be similar to those for the latest U.S. Navy Submarine "Skipjack". This necessitated modifying the hull of the "Dreadnought" to accommodate the reactor. The main objective of the transfer was to speed up the construction of similar nuclear propulsion plants for the Royal Navy. The hull design of the "Dreadnought" to be based on the "Albacore" form developed by the U.S. Navy.

1959 (June 12).—Laying of the keel of the "Dreadnought".

Great Britain has been fortunate in obtaining for the "Dreadnought" a U.S. Navy reactor which has proved successful in service. In addition, this transfer of a complete nuclear power plant with technical and research information has also the desired result of reducing considerably the expenditure on design, development and research into new types of reactors.

The commander and the principal officers and ratings for Britain's first nuclear-powered submarine "Dreadnought" were selected on March 25, 1959. The Admiralty announced that her captain is to be Lieutenant-Commander B. F. P. Samborne, now training at the Royal Naval College, Greenwich. The engineer officer will be Lieutenant-Commander P. G. Hammarsley, who is studying at the Imperial College of Science. Sixteen officers and thirteen senior ratings have been chosen up to now. The officers are obtaining theoretical instruction at Greenwich where a chair of nuclear science and technology has recently been established. After the completion of these various courses the officers and ratings are to be sent to America where they will gain practical instruction and operating experience in nuclear power plant.

1. Experimental reactor "Neptune" at Harwell

During the period 1947 to 1957 at least ten widely different experimental reactors were built and thoroughly explored at Harwell, the first being Gleep (Graphite Low Energy Experimental Pile), which was first started up on August 15, 1947. It seems rather strange that not a single one of these reactors is of the pressurized light water moderated and cooled type, whilst in America this reactor was already accepted in 1946 as most suitable not only for land power stations but also for nuclear marine propulsion.

Great Britain has concentrated during the past decade on the graphite-moderated and gas-cooled reactor for land power stations. As soon as it was finally decided to proceed with the design and the construction of a nuclear-powered submarine and to install a pressurized light

Table I.—A SUMMARY OF THE DESIGN DATA AND THE ESSENTIAL PARTICULARS OF NUCLEAR PROPULSION PLANTS PROPOSED BY EIGHT BRITISH MANUFACTURING GROUPS

Item	Project	Unit	A	B	C	D	E	F	G	H
	GROUP		U.K.A.E.A.	A.E.I.-J. Thompson	Babcock and Wilcox	Vickers Rolls-Royce Foster Wheeler	G.E.C.-Simon-Carves	Mitchell-Fairfield	De Havilland	Hawker-Siddeley
	Type of Reactor		AGR	BWR	PWR	HWR (Steam cooled)	GGCR	BWR	HTGCR	OMR
1	Net output	shp	35000	25000	65000	—	—	25000	50000	17000
2	Number of reactors	—	1	1	1	1	1	1	2	1
3	Heat rating of each reactor	MW	100	82	180	—	150	—	75	56
4	Total heat rating	MW	100	82	180	—	150	—	150	56
5	Moderator	—	graphite	light water	light water	heavy water	graphite	light water	graphite	terphenyl
6	Coolant	—	CO_2	light water	light water	steam	CO_2	light water	helium	terphenyl
7	Fissile material	—	enriched UO_2	enriched UO_2	enriched UO_2	low enriched UO_2 (pellets)	slightly enriched UO_2		uranium and thorium carbides	enriched UO_2
8	Enrichment	%	1·65	2·1	2 to 4%	—	—	—	90% U235	1·4
9	Weight of UO_2	kg	14000	—	—	—	—	—	67	—
10	Weight of ThO_2	kg	—	—	—	—	—	—	674	—
11	Total weight of UO and THO	kg	14000	—	—	—	—	—	741	—
12	Maximum fuel temperature	°F	—	3632	—	—	—	—	2732	—
13	Maximum temperature of can material	°F	1112	572	—	—	—	—	—	—
14	Mean reactor rating	MW/tonne	7·75	17·2	—	—	—	—	101	—
15	Peak reactor rating	MW/tonne	18·0	—	—	—	—	—	—	—
16	Life time of fuel at full power	days	—	380	500	—	—	—	400 to 650	—
17	Year of service	—	—	—	2 to 5	—	—	—	4	—
18	Average fuel burn up	MWD/tonne	—	10000	—	—	—	—	65600	—
19	Thermal efficiency	%	32	27	—	—	—	—	→	24·8
20	Estimated weight of steam raising unit and shielding	ton	—	1600	—	—	—	—	—	—
21	Estimated weight of turbines, gears and ancillaries	ton	—	250	—	—	—	—	—	—
22	Total estimated weight (20 + 21)	ton	—	1850	—	—	—	—	—	—
23	Total weight of installation	ton	—	—	3000	2100	2400	—	2400	—
24	Specific weight of plant	lb/shp	400	166	—	—	200	—	—	—
25	Specific cost of plant	£/shp	—	—	—	—	—	—	28	—
26	Eventual cost of fuel	d/shp	—	—	0·3 to 0·6	—	—	—	—	—
27	Fuel cost at 6000 MWD/tonne burn up	d/shp	0·2	—	—	—	—	—	—	—
28	Cost of coolant make up	d/shp	—	—	—	—	—	—	—	0·07
29	Capital cost above conventional plant	%	50 to 100	—	—	—	—	—	—	—
30	Operating cost above conventional plant	%	10 to 15	—	—	—	—	—	—	5
31	Number of heat exchangers	—	—	—	—	—	4	—	6	—
32	Diameter of heat exchangers	—	—	—	—	—	—	—	—	—
33	Number of steam drums	—	—	2	—	—	—	—	—	—
34	Maximum pressure of primary circuit	psig	270	1000	1750	about atm	—	—	735/1000	100
35	Maximum temperature of primary circuit	°F	617	547	500	194	—	—	1292	761
36	Pressure at turbine stop valve	psi	—	—	410	—	—	—	600	480
37	Temperature at turbine stop valve	°F	—	—	447	—	—	—	850	710
38	Evaporation	lb/hr	—	—	616000	—	—	—	—	—

Project	Item	Remarks
C	23	Includes: reactor, heat exchangers, ancillary equipment, containment vessel and shielding
D		Type of reactor: pressure tube design
E		Fuel element and control channels horizontal
G	7	Fuel bonded into graphite pellets sealed in impermeable graphite blocks
G	23	Two reactors and twelve heat exchangers
G	25	Cost of first production of twin reactor unit less fuel £1·4 million, i.e. £28/shp

water moderated and cooled reactor, which had proved so successful in the U.S. submarine "Nautilus" since it went into commission on January 17, 1955, it was considered imperative to build first of all an experimental reactor, the Neptune, and also a land-based nuclear power plant for H.M.S. "Dreadnought". The zero-energy reactor Neptune was principally used:

(a) to study the behaviour of neutrons in light water-moderated core design, with specific reference to a pressurized-water reactor for submarine propulsion
(b) to check the design calculations for the land-based prototype.

The Neptune uses enriched uranium as fuel and ordinary water as the moderator. The reactor is so designed that a number of different cores can be easily inserted. The core of the reactor consists of boxes of fuel element plates inserted in a large heavily shielded aluminium tank which contains the water moderator. The level of the water in the tank can be adjusted accurately to any desired level. By this means it is possible to regulate the heat output of the reactor, which is not pressurized. As the heat output is small, boiling cannot occur even at atmospheric pressure. The water can be heated to about 185°F which enables the variations in neutron behaviour to be studied at increased moderator and fuel temperatures. The moderator temperature is raised and controlled by electric heaters of about 150 kW capacity and an air-blown cooler.

Rolls-Royce Limited, as a member of Vickers Nuclear Engineering Limited, were mainly responsible to the Admiralty for the design and the construction of Neptune. The Atomic Energy Research Establishment at Harwell was authorized to provide advice, especially relating to physics, instrumentation and safety, during design, construction and operation, and in addition to supply the reactor building, the fuel and all essential services. The experimental programme was carried out jointly by a team of scientists from Harwell and the Admiralty, assisted by physicists from Rolls-Royce Limited and Vickers-Armstrongs. Only certain detailed particulars of the Neptune have been published and these are summarized below:

1. Enriched fuel:
   Contained in stainless steel boxes. Several hundred of these are required to build the maximum core size capable of being housed in the tank.
2. Fuel plates:
   (a) Length, 12 in.
   (b) Width, 3 in.
   (c) Thickness, 0·020 in.
3. Control shins:
   (a) Number, 6
   (b) Material, cadmium
   (c) Thickness, about $\frac{3}{32}$ in.
   (d) Time from release to control shins reaching 4 in. from the bottom position, 1·2 sec
4. Reactor tank:
   (a) Made of aluminium with a low copper content to reduce corrosion and prevent contamination of the moderator
   (b) Shape, cylindrical
   (c) Diameter, 8 ft
   (d) Height, 14 ft
   (e) Thickness, $\frac{1}{4}$ in.
   (f) Supported on a heavy steel structure in a pit
5. Reactor pit (concrete):
   (a) Dimensions, 27 ft. × 15 ft × 24 ft deep
6. Building (hangar type):
   (a) Contains the control room, the fuel storage, maintenance workshops and three laboratories
   (b) Dimensions, 80 ft × 60 ft
7. Shielding:
   (a) Fixed and movable concrete assemblies
   (b) Thickness, 4 ft

2. Land-based prototype submarine propulsion plant

This unit is to be installed adjacent to the Atomic Energy Authority's Establishment at Dounreay, Caithness. Information is scanty but it appears that the entire project is being designed and developed in Great Britain. It seems, however, that the core will be based principally on U.S. experience and will therefore be similar to that approved for the "Dreadnought". The plant will be used for the training of naval crews as well as for research.

It is useful at this stage to recapitulate the progress of United States first land-based submarine, STR Mark I, at A.E.C.'s National Reactor Testing Station at Idaho Falls, Idaho:

(a) Westinghouse Electric Corporation received the official contract in June, 1948
(b) Construction was started in August, 1950
(c) The reactor went critical on March 30, 1953.

Table II.—DESIGN INFORMATION, DIMENSIONS AND WEIGHTS OF NUCLEAR REACTORS FOR MARINE PROPULSION PLANTS

	Project		A	B	C	D	E	G	H
	Group			A.E.I.-J. Thompson	Babcock and Wilcox	Vickers Rolls-Royce Foster Wheeler	G.E.C.-Simon-Carves	De Havilland	Hawker-Siddeley
	Type of reactor	Unit	U.K.A.E.A. AGR	BWR	PWR	HWR	GGCR	HTGCR	OMR
1	Heat rating of each reactor	MW	100	82	180	—	150	75	56
2	Core diameter	ft	15 ft	5 ft 2 in.	—	—	7·5	6·0	5·2
3	Core length	ft	14 ft	6 ft ½ in.	—	—	6·75	6·0	5·0
4	Number of fuel channels	—	250	104	—	—	—	1729	264
5	Number of fuel elements per channel	—	—	36	—	—	—	9	19
6	Total number of fuel elements	—	—	3744	—	—	—	15561	5016
7	Thickness of fuel cans	in.	—	0·033	—	—	—	—	—
8	Material of fuel cans	—	—	zircaloy	stainless	stainless	stainless	—	stainless
9	Maximum fuel temperature	°F	—	3632	—	—	—	2732	—
10	Maximum temperature of the can material	°F	1112	572	—	—	—	—	—
11	Maximum temperature of the graphite	°F	—	—	—	—	—	1814	—
12	Number of control rods	—	25	—	—	—	—	—	—
13	Coolant	—	CO_2	light water	light water	heavy water	CO_2	helium	terphenyl
14	Pressure of the coolant	psig	270	1000	1750	about atm.	—	735/1000	100
15	Inlet temperature of the coolant	°F	482/617	547	—	122	—	392	563
16	Outlet temperature of the coolant	°F	932/1067	—	—	194	—	1292	628
17	Temperature rise of the coolant	°F	450/450	—	—	72	—	900	65
18	Pumping power of each reactor	kW	—	—	—	—	—	530	—
19	Weight of core	ton	—	8·7	—	—	—	—	—
20	Weight of moderator and reflectors	ton	200	—	—	—	—	—	—

Table III.—DETAILS OF REACTOR AND CONTAINMENT VESSELS, HEAT EXCHANGERS AND DUMP CONDENSER FOR MARINE PROPULSION PLANTS

Item	Project	Unit	A	B	C	E	G
	Group		U.K.A.E.A.	A.E.I.-J. Thompson	Babcock and Wilcox	G.E.C.-Simon-Carves	De Havilland
	Type of reactor		AGR	BWR	PWR	GGCR	HTGCR
1	Heat rating of each reactor	MW	100	82	180	150	75
2	Shape of reactor vessel	—	cyl.	cyl.	—	cyl.	—
3	Diameter of reactor vessel (i.s.)	ft	21	8	—	14	—
4	Height of reactor vessel	ft	—	30	—	—	25 o.a.
5	Design pressure of reactor vessel	psi	—	1250	—	—	—
6	Design temperature of reactor vessel	°F	—	572	—	—	—
7	Length of bottom support grid for reactor	ft	—	—	—	56·5	—
8	Weight of reactor vessel	ton	—	—	—	125	—
9	Weight of bottom support grid for reactor	ton	—	—	—	200	—
10	Diameter of containment vessel	ft	—	38	42·5	—	—
11	Overall length of containment vessel	ft	—	55	—	—	25·33
12	Thickness of containment vessel	in.	—	2¼	—	—	—
13	Total volume of containment vessel	cu ft	—	—	—	68000	—
14	Weight of containment vessel	ton	—	—	—	243	—
15	Outlet pressure from heat exchanger	psi	620/670	—	—	—	—
16	Outlet temperature from heat exchanger	°F	860	—	—	—	—
17	Thickness of shielding	ft	9¼	—	—	—	—
18	Rating of dump condenser	MW	100	—	—	—	—

These dates show that Great Britain is about nine years behind America in nuclear power plant for marine propulsion.

3. The submarine "Dreadnought"

The contract with the Westinghouse Electric Corporation for a complete nuclear power plant has considerably reduced the period for the completion of the submarine "Dreadnought". Rolls-Royce Limited, who have been appointed by the Admiralty to take a special interest in the project, are to manufacture the fuel elements for the reactor. The United States is to supply the enriched fissile material and provision is made for the Royal Navy to obtain it until 1968. The officers and ratings to operate the "Dreadnought" are to be trained by the U.S. Navy, both at sea and in the shipyards. It is expected that the "Dreadnought" will be in commission by 1962 instead of 1964 as originally planned before the American agreement was signed.

4. Projects for Britain's first nuclear-powered merchant vessel

For the past two years British engineers have been directing their efforts on the preparation of schemes on nuclear power plants for the propulsion of merchant ships. By the first week of May, 1959, eight prominent nuclear groups, and engineering and naval experts, attended a conference, arranged by the Marine Nuclear Propulsion Committee under the chairmanship of the Civil Lord of the Admiralty, Mr. T. G. D. Galbraith. The main objective was for each group to present a paper and illustrate the details of the project. The Atomic Energy Authority and seven rival nuclear engineering and marine groups each submitted a reactor system. These are summarized below:

	Group	Type of reactor	Project
1	Atomic Energy Authority	Advanced gas-cooled	A
2	A.E.I.-John Thompson Nuclear Engineering Company	Boiling light water	B
3	Babcock and Wilcox	Pressurized light water	C
4	Vickers Nuclear Engineering (Vickers, Rolls-Royce, Foster Wheeler)	Steam cooled heavy water	D
5	General Electric - Simon-Carves Atomic Energy	Graphite moderated gas-cooled	E
6	Mitchell Engineering Limited and Fairfield Shipbuilding and Engineering Company	Boiling light water	F
7	De Havilland Engine Company	High temperature gas-cooled	G
8	Hawker Siddeley Nuclear Power Company	Organic liquid-moderated	H

The Admiralty have indicated that the recommendations and the specifications are sufficiently comprehensive to enable them to assess the technical and economic merits of these fairly widely different types of reactors, and a special technical committee has been appointed to examine the various projects.

Some significant features of the reports are:

(a) All the reactors require a fuel enriched either with fissile uranium 235 or with plutonium 239, produced in existing reactors based on natural uranium

(b) Most of the schemes were only in a preliminary stage of design and development.

(c) Others required an intensive research programme

(d) Some firms had emphasized that their nuclear power plant would be ready to go to sea for trials within 30 months

(e) Certain designs revealed that the cost of construction was comparatively low. One of them suggested that a nuclear power unit of 32 MW (heat) could be built for about £750,000

(f) The power outputs ranged from 25 to 50 MW shp, sufficient to drive the largest cargo vessels at a moderate speed or ocean liners of smaller displacement.

A number of the reactor types in the list are already used in power stations and for marine propulsion:

(a) Pressurized light water moderated and cooled reactor. This is undoubtedly America's foremost power reactor and the U.S. Navy's only marine type. Such reactors are installed in:

(1) Large power stations at Shippingport, Rowe (Yankee) and Indiana Point, having thermal ratings of 232 MW, 392 MW, and 585 MW respectively

(2) 33 U.S. submarines, one destroyer, one guided missile destroyer, one guided missile cruiser, and one attack aircraft carrier

(3) The first nuclear-powered merchant vessel in the world, the U.S. "Savannah".

(For further details see MECHANICAL WORLD, May, August and September, 1958.)

(b) Boiling light water reactor.—This is America's No. 2 reactor. There are a few experimental ones and at the moment a single power reactor, installed at Dresden station of the Commonwealth Edison Company. The thermal rating is 624·2 MW.

(c) Graphite-moderated and gas-cooled reactor.—At present this is the only well-established power reactor in Great Britain. Unfortunately this country has shown no interest in the pressurized and boiling light water reactor for power stations. Only recently have we been experimenting with the zero-energy light water reactor Neptune and this is in connection with the submarine project.

(d) Advanced gas-cooled reactor (A.G.R.).—This reactor has been proposed by the U.K.A.E.A. for the nuclear-powered merchant ship. This experimental reactor was sanctioned for construction towards the end of October, 1958. The detailed particulars are summarized in MECHANICAL WORLD, April, 1959, page 162.

(e) The following reactors are in the experimental stage:
  (1) Steam cooled heavy water
  (2) High temperature gas-cooled
  (3) Organic liquid-moderated.

A comparison of the design and the performance data of the eight projects with essential particulars of the reactors, the reactor and containment vessels and the heat exchangers is presented in Tables I, II, and III.

Unitized Microfilm System for Drawing Offices

The reproduction of large numbers of engineering drawings is remarkably economical when done by the new "Copyflo" continuous printer. The machine uses the xerographic process and therefore copies drawings on to ordinary low-cost unsensitized paper, producing 20 ft of prints a minute.

The machine referred to is the Model 5 which is designed to print continuously from single frames of microfilm inserted in punched cards. This combination is known as "unitized microfilm", the microfilms being made from the original drawings without any need for linen tracings. The film is cut into single frames and each is inserted into the aperture of a "Filmsort" punched card.

The punched card enables films to be found more quickly than by any other method since the coding leads directly to it, and mechanical means can be enlisted if required to speed up the process.

The Copyflo machine, which is made by Rank-Xerox Limited, 33–41 Mortimer Street, London W1, can be pre-set to produce from each card either single or specified numbers of enlargements. It will also print on to master material for further copying by offset or dyeline. The cost of materials used in the Copyflo system is less than one penny per square foot of print.

Portable Potentiometer Recorder

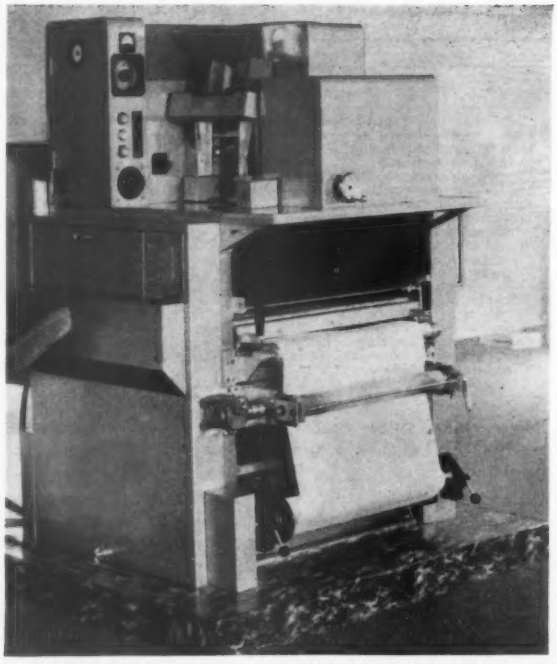
A light-weight, self-contained recording instrument with a power driven pen is available for use in any location where mains supplies are not available. The Mervyn portable potentiometer recorder is completely miniaturized and portable. It is battery operated and weighs only 10 lb. Fully transistorized, it contains no thermionic valves or other devices that would lead to high battery consumption.

The recording chart has a width of 4 in. and is driven by a clockwork motor which can operate continuously for 8 days.

Whilst particularly suitable for temperature recording it can also be supplied with a range of input circuits for such differing purposes as Ph recording, weight recording (using electronic load cell) or wind recording. It can also be used in conjunction with the Mervyn polarographic electrode for dissolved oxygen recording.

The transistorized chopping system has no moving parts, and the chopping is done at 1,000 cps, thus minimizing difficulties of 50 cycle interference. The all-transistor amplifier uses a printed wiring board and the motor-drive is by permanently magnetized d.c. motor. Voltage reference is derived from a Zener diode.

The instrument is made by Mervyn Instruments, St. Johns, Woking, Surrey.



The Copyflo Model 5, has a printing spread of 24 in. Input is of punched cards, each containing a frame of microfilm on which is recorded an engineering drawing and from this the Copyflo makes enlargements by automatic xerography on to plain paper at the rate of 20 ft per min. The Model 5 also prints from roll microfilm and can print on to offset or dyeline master material

Wide-bore Quick-acting Coupler

To their range of heavy duty type quick-acting couplers Schraders, of 829 Tyburn Road, Erdington, Birmingham 24, have added one with an inlet thread of $\frac{3}{4}$ in. This wide bore is particularly suited to the pnuematic tools used in shipyards and for pnuematic drills and similar equipment which is power fed through wide bore hose.

The complete coupler consists of two parts—a check unit which is fitted to the air line or supply from the compressor and an adapter which is fitted to the hose of the tool or equipment. When the adapter is pushed into the check unit it opens the line pressure to the tool, and at the same time snaps into a locked, airtight connection. The adapter will not disconnect accidentally, yet a twist on the sleeve of the check unit will release the adapter and immediately reseal the air line. When coupled the adapter swivels in the check unit to avoid kinking the hose. The rate of free air flow through the coupler is approximately 100 cu ft per min at 100 psi inlet pressure.

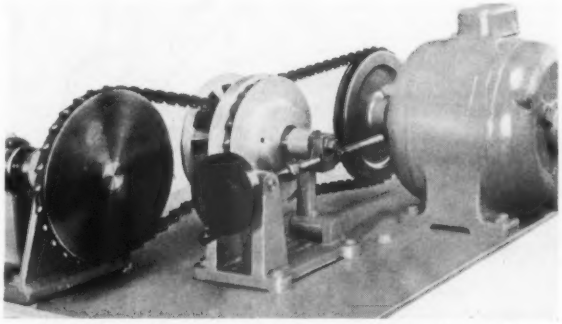
SENSITIVE BENCH DRILL.—After being out of production for a number of years, this high speed sensitive bench drilling machine has been re-introduced by A. A. Jones & Shipman Limited, Leicester. It is for drilling small holes up to $\frac{1}{16}$ in. dia in light work and is built to run continuously at high speeds up to 6000 rpm. A sensitive spindle feed and micrometer depth stop enable small holes to be drilled accurately on a production basis. The machine has built-in lighting

Infinitely Variable Speed Unit

The "Ribble" infinitely variable speed unit is the second component to be produced by the new Power Transmission Division of B. & F. Carter & Co. Limited, of Bolton. It covers a range of $\frac{1}{2}$ to $2\frac{3}{4}$ hp with an input speed of 1,440 rpm and gives a smooth stepless speed variation. Control is by hand-wheel, or remote control, Drive is by 40° $\frac{1}{2}$ in. V-ropes of either continuous or link type.

The $6\frac{1}{2}$ in. variable pulleys cover speed ratios between 2:1 and 6:1, the pulleys being interlocked at all times. They are made from a high tensile aluminium alloy and run on a ground spindle with oil-impregnated phosphor-bronze bushes in the rotating sleeve.

No springs are used in the construction and adjustment is by handwheel and screw, the range being fixed by two pairs of locknuts on the screw. The handwheel is screwed directly to the adjusting spindle and locked in position with a standard locknut: it is simple, therefore, to attach a remote control, flexible shaft or servo-motor.



The Ribble variable speed unit covering speed ratios between 2:1 and 6:1

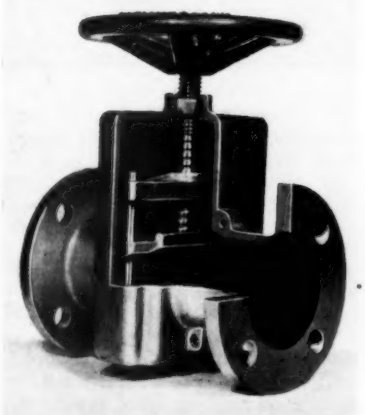
Cold Box for Metal Treatment

The new Philips cold box installation is believed to be the first of its kind in the world with a net content of about 400 litres for temperatures down to minus 160° C. Refrigerating capacity at minus 100° C is 4400 Btu/hr and 2560 Btu/hr at minus 160° C. The cold box can be cooled at any pre-set temperature by the circulation of cold gaseous air which is cooled down on a specially-designed head of the Philips gas refrigerating machine. By means of an additional device, liquid air—which is of particular importance for the transport of products in dewar flasks, etc—can also be produced.

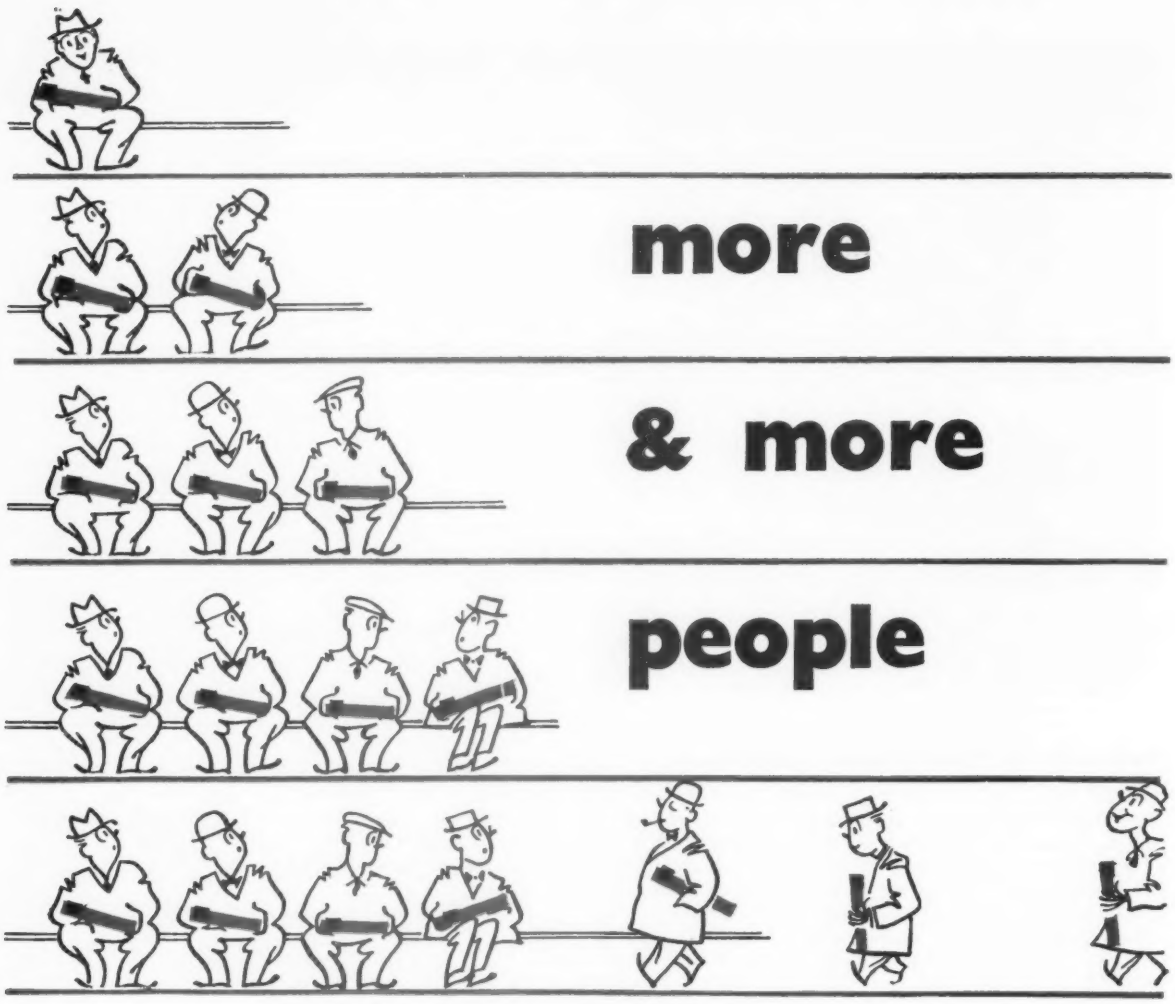
A special head with an air circulating fan and driven by a built-in motor has been developed for the circulation of the cold gaseous air. The temperature control system consists of a resistance thermometer and a phase-sensitive relay unit; the latter is of the type used in Philips temperature recorders. For the recording and automatic controlling of box temperature there are available an electronic temperature recorder, a programme transmitter and a multi-point potentiometer recorder. Further, the installation can also be made suitable for the production of liquid air during the periods that cooling of the box is not required with the aid of a special ice separator and a liquid air delivery pipe.

Among applications for which the cold box installation is eminently suitable are the low temperature treatment of metals, shrink fitting, the prevention of ageing of aluminium and magnesium alloys, the chilling of stainless steel and the environmental testing of electrical components.

The distributors in the United Kingdom are Research and Control Instruments Limited, 207 King's Cross Road, London WC1.



DIE-CAST PINCH VALVE.—Claimed to be the first pinch valve of die-cast construction the Rowe pinch valve is made of aluminium alloy with reinforced sleeves all of which are suitable for pressures up to 100 psi. The main casing is split on its vertical axis for ease of assembly and servicing, and completely encloses the flexible sleeve and operating mechanism. The screwed spindle has two right-hand threaded portions, the lower thread being twice the pitch of the upper section. The upper fine-pitch thread engages in a nut which is held in recesses formed in each half-casing, while the lower coarse thread engages with the rising bridge which is connected by two rods to the lower anvil. Screwing down the handwheel to close the valve by a distance equal to one half of the valve bore causes the coarse threaded section of the spindle to raise the bridge and lower anvil a similar amount to pinch the sleeve equally about its centreline. The reinforced sleeves are available in four grades of natural or synthetic rubber materials to handle alcohol and milk; petroleum products; tar and ammonical liquors; abrasive materials and general purpose duties. The Rowe pinch valve is made by W. H. Rowe and Son Limited, Quayside Road, Southampton in sizes from 1 to 3 in. bore. Illustrated is the 2 in. valve which is 8 in. long over the sleeve, and has a maximum height of $8\frac{1}{2}$ in. from the centre of the sleeve to the top of the handwheel. The weight is 10 lb and the list price £6. 10s. 0d.



use Eclipse

'Eclipse' hacksaw blades and other tools are made by James Neill & Co. (Sheffield) Ltd. and are obtainable from all tool distributors.

UH 35

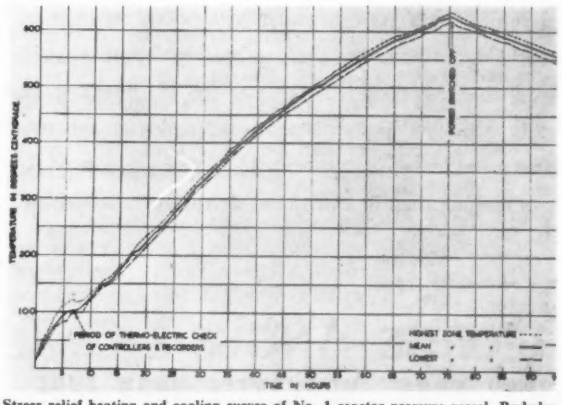
Stress Relieving a Large Reactor Pressure Vessel

2½ MW installation on site

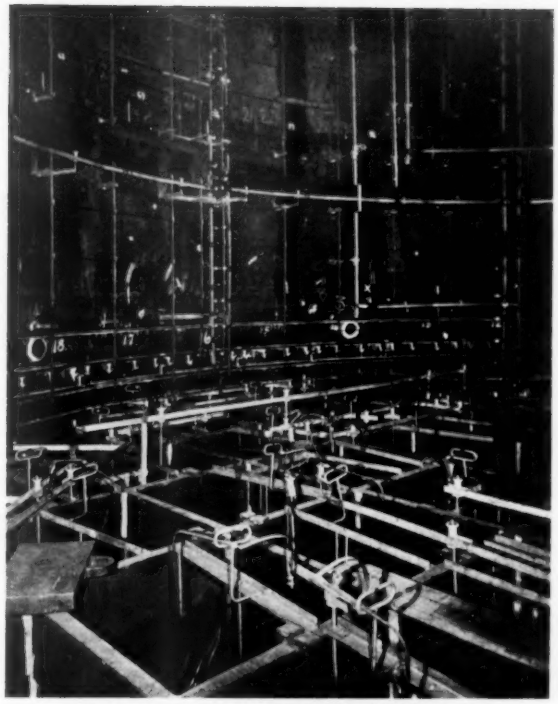
WITH the completion of pressure tests, the number one reactor pressure vessel at Berkeley Nuclear Power Station becomes the world's largest reactor pressure vessel ever to be stress relieved. Working closely throughout with John Thompson Limited, who are responsible for design and construction of the reactor vessel, the stress relieving installation was planned, erected and its operation supervised by the Electric Resistance Furnace Company Limited. Faced with the task of heat treating in one operation, a mild steel vessel weighing 1000 tons, this company installed equipment requiring a 2½ MW power supply.

The reactor vessel, 80 ft high, 50 ft dia and having a capacity of 142,000 cu ft was erected on site from sections of 3 in. and 4 in. thick mild steel plate. The erection involved 2500 ft of welding. In the top and bottom domes of the vessel there are large diameter ports for the circulation of the gas to be heated by the reactor and other openings in the top dome for the operation and control of the nuclear pile. Inside the vessel, the steel diagrid for the support of the nuclear unit weighs 165 tons.

The heating of this vessel presented many problems apart from determining the power required and the method of its distribution to obtain uniform heating. Allowances had to be made for change in the shape and size of the vessel because of increased temperature. Accurate temperature measurement and control were essential at a position remote from the vessel. The heaters had to be installed in a humid atmosphere



Stress relief heating and cooling curves of No. 1 reactor pressure vessel, Berkeley Nuclear Power Station (C.E.G.B.)



Interior of pressure vessel after installation of heating system

caused by the setting concrete of the outer biological shield.

For the heating of the vessel and its diagrid, 8500 ft of sheathed radiant heaters were installed. These heaters were mounted on specially designed supports erected within the vessel which was lagged externally, with Caposite and Rocksill insulation. The electricity supply to the heaters was carried by a complicated system of bus-bars entering the vessel through two of the gas ports which were then closed to reduce heat losses. The heaters were arranged in twenty-four independently controlled zones, the twenty-four automatic temperature controllers together with four six-point temperature recorders being installed in a separate control room from where the whole of the stress relieving operations were regulated.

For the measurement, control and recording of temperatures, some 400 thermocouples were used. The control and recording couples were welded to heat-resisting-alloy blocks which were afterwards clamped into contact with the surfaces to be checked. Leads from the control couples were taken direct to the instruments where rheostats were used to compensate for increase in the electrical resistance of the couples with temperature rise. Connexions to the recorder couples were made through cold junction boxes. The accuracy of the complete thermo-electric circuit was checked during the early stages of the stress relieving operation.

The minimum temperature specified for the relief of all stresses set up during construction of the vessel was 575° C and this temperature was reached in 65 hr. The heating was continued for another 10½ hr, bringing the vessel to within 22° C of the maximum permissible temperature of 650° C. When the power to the heaters was removed the fall in temperature to 575° C took 11 hr,

the whole of the vessel having then been held within the prescribed temperature limits for 21½ hr. The natural cooling of the vessel to atmospheric temperature took approximately eleven days.

The success of the heating operation was proved by the mass of temperature recordings. These showed that the temperature of all parts of the vessel, including the diagrid, rose smoothly at a constant rate and that the temperature distribution was at all times uniform. In spite of the differences in wall thicknesses of the vessel and in the type of construction involved in the walls and the diagrid, the highest and lowest temperatures recorded at any moment seldom differed by more than 15° C. The ultimate temperature of 628° C was reached with a uniformity of ± 7° C. The heat treatment was well within the limits set by appropriate British Standards Specifications for the stress relieving of reactor vessels.

The vessel, which must withstand a working pressure of 125 psig was tested at a pressure of 211 psig and has been accepted by Lloyds on behalf of the Central Electricity Generating Board.

The Efco heating equipment will be used again to stress relieve the second reactor vessel which is nearing completion.

Two-mile Submarine Pipelines

What are believed to be the longest submarine pipelines ever constructed in this country have been launched at the United Kingdom Atomic Energy Authority Establishment, Winfrith Heath, Dorset. The pipelines, two, lying side by side, and each over two miles long, will carry effluent out to sea beyond Arish Mell.

The pipelines are 6 in. dia and of ½ in. thick mild steel, coated with bitumen and glass-fibre wrapping approximately ¼-in. thick, and surrounded with a 1½-in. thick coating of reinforced concrete to assist in the protection of the pipe during the launching pull and as it rests on the sea bed. They were constructed in twenty 1200-ft long sections.

The launching consisted of pulling out twin 1200-ft long sections, by means of a winch on an anchored barge at sea, with a holdback winch on the launchway controlling the movement, while another holdback was employed for securing the leading length of pipe in between pulls. Buoys at intervals en route reduced the dead-weight. Ten major pulls of the pipe were required, each taking between one and two hours. Between pulls, the operations of rolling the pipes to position, strapping them in pairs, welding up, radiographic examination and concreting the closing joints, took a further six to eight hours. Prior to launching the sea bed was prepared to a profile such that the pipes would not lie to a radius of less than 1500 ft. Divers had to blast through five reefs in the course of the preparation.

Launching and construction of the sea pipelines (and construction of the last mile of the overland lines) were carried out by Taylor Woodrow Construction Limited in association with Collins Submarine Pipelines Limited.

The sea pipelines are a continuation of the five-mile long overland section. This consists of two sets of twin pipes, with an inner pipe, 6 in. dia, for radio-active effluents, within an outer pipe, 12 in. dia for ordinary effluents.

The land pipes branch into two pairs of 6-in. pipelines at the control chamber at Arish Mell, one pair, for ordinary effluents, continuing to 50 ft below low-water mark and the other pair being the pipelines which were taken out to sea, where they will end in approximately 100 ft of water (no discharge of radio-active effluent will take place until authorization has been given by responsible Ministries).

The land pipes generally are buried with a minimum cover of 3 ft but through a gunnery range they are laid to a minimum depth of 8 ft.

The whole of the pipeline system is protected cathodically against corrosion.

The effluents arising at Winfrith, after treatment and temporary storage in the sea disposal tanks on site, are to be pumped to a break pressure tank located three miles along the line at a point just north of Lulworth Park. From there they gravitate a further two miles to the control chamber at Arish Mell, and thence out to sea under operational control.

Vickers Nuclear Marine Proposal

The marine heavy water moderated steam cooled reactor which has been submitted to the Civil Lord's Committee in the context of a nuclear surface vessel by Vickers Nuclear Engineering has been designed from scratch as a marine plant and is a wholly British design in which existing technology has been used throughout to avoid prolonged testing and development. Heavy water is used as moderator and is kept at low temperature and almost atmospheric pressure, and dry steam at conventional temperatures and pressures is used for cooling, and losses of coolant can be readily made up from ship's fresh water plant.

Control is by level changes of moderator and hence there are no moving parts in the core. Since only fluids have to move in the core no problems of securing the moderator in place and possible jamming of control rods arise. The self-driving steam cooling circuit is used in preference to a pump circuit.

Fuel element design is simple and employs uranium oxide pellets sheathed in stainless steel cans. Low enriched fuel is used and the design is suited to the use of plutonium for enrichment instead of U235. Materials have been chosen that will not react chemically with each other or with sea water—UO_2, stainless steel, aluminium and water.

The equipment inside the containment shell is largely stationary. The only moving parts are outside the core and are comprised of the canned heavy water circulating and control pumps, the control valves, isolating valves and primary circuit feed pumps. All have been designed to fail safe without immediate external control action.

In the prototype study, a secondary steam circuit with its heat exchangers is included but it is hoped that open cycle operation may prove possible, resulting in saving in weight, and the turbines operating at higher load and pressures and temperatures. The proposed design has a high degree of inherent stability and the control system proposed will be capable of following all normal operational demands. The weight of the plant is 2,100 tons and this includes containment and secondary heat exchangers.

A pressure tube design is used to permit scaling of the reactor up and down to meet requirements for reactors of different output.

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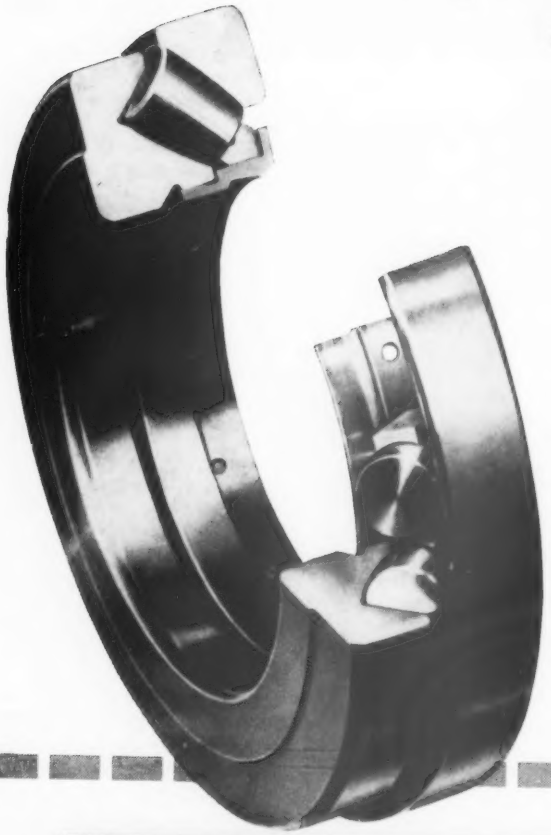
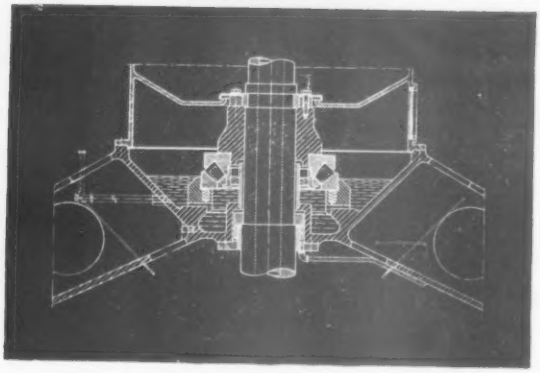
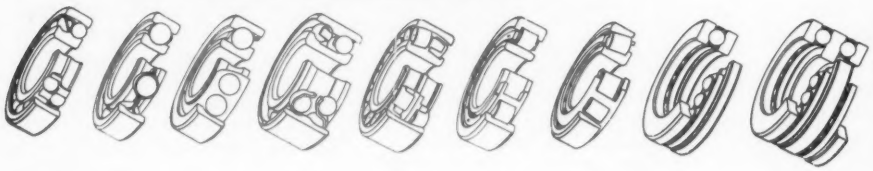


The spherical roller thrust bearing has one row of obliquely disposed rollers guided by a high flange on the shaft washer and running on a sphered track on the housing washer. It combines very high carrying capacity with complete self-alignment. The surface of the roller end next to the guiding flange is so formed that the rollers are always separated from the flange by an oil film when under load. The bearing can therefore be used at relatively high speeds, even if the load is very heavy. Unlike other thrust bearings, it can also carry radial loads.

Technical advice on the application of spherical roller thrust bearings, as well as other types of rolling bearings is always readily available from Luton or from any one of the twenty Skefko Branch Offices in the British Isles.



Support bearing for vertical electric generator



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Vibration Engineering.—By W. Ker Wilson. London, 1959; Charles Griffin & Co. Limited. 90/– net (by post 91/9). 292 pp. $7\frac{1}{4} \times 9\frac{3}{4}$ in.

The complexity and the extent of the calculations relating to vibration in engine design are well known, and it is generally known that advanced work is now done with the aid of computers, and not only desk calculating machines but by electronic digital machines also. These are a real boon to the investigator. For instance, as Dr. Wilson explains in this book, in torque summation an instruction can be included in the computer programme that, if the final torque is not zero, the calculation is to be repeated with adjustments to the constants until zero is reached or very nearly approached. This cuts out all mental trial and error and tedious repetition.

The first part of Dr. Wilson's new book (he is already well known for his other books) is devoted not only to describing the fundamentals of torsional vibration analysis and engine balancing but also to showing how the computing tasks can be broken down into elementary arithmetical steps which can be set down in tabular form for use with desk computing machines or for programming for the automatic digital computer. Treated in Part I are frequency calculations, relative amplitudes at masses, forced vibration amplitudes at non-resonant speeds, amplitudes at resonant speeds, the investigation of multi-cylinder in-line internal combustion engines, and engine balance. Part I is concluded by a fully worked numerical example of a three-mass system.

The second part is much the longer and deals with the theory and practice of vibration isolation. Dynamic balancing is commonly practised nowadays and consequently it is possible to use resilient mountings successfully for preventing the transmission of vibration. The principles are explained and the various methods in use explored in great detail, particularly as regards calculations for design purposes. Frequency calculations are explained and close attention given to the forced vibration of a body free in space, the forced and resonant vibration of spring-controlled bodies, and to critical speed diagrams, foundation vibration and the influence of elastic foundations. As with the first part Part 2 ends with a completely worked numerical example, this one concerned with the determination of the characteristics of a flexible mounting system for a four-cylinder oil engine with generator.

Progress in Nuclear Energy: Metallurgy and Fuels.—London, 1959; Pergamon Press. £7–7–0 net (by post £7–9–0). 653 pp. 6 × 9 in.

This book is Volume 2 in the fifth of twelve series of books under the general title of "Progress in Nuclear Energy". The whole is a comprehensive study of the subject from its chemistry and engineering to law and health. Taking this one volume as an example we find it to be a truly authoratative compendium by some fifty authors whose contributions are in two groups; basic materials and solid state physics and physical metallurgy. The materials covered

books

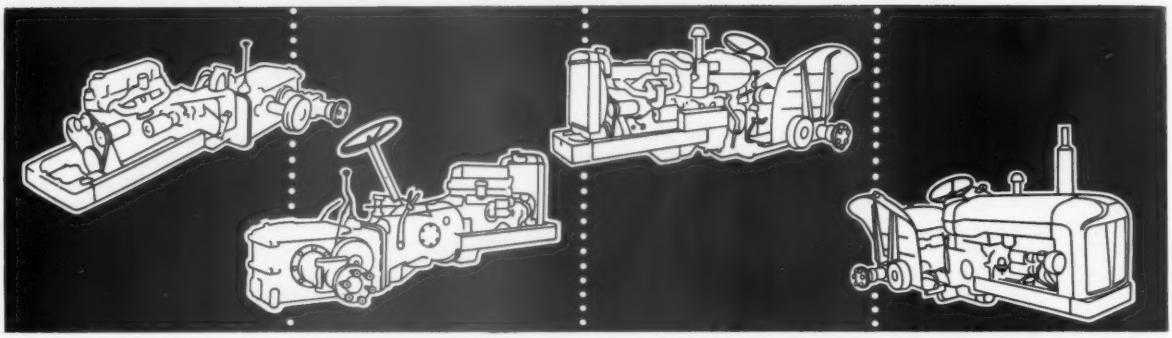
are uranium, thorium, magnesium, plutonium, zinconium, beryllium, reactor control materials, ceramics, and fuels and fuel components. The physics section deals with the alloys of the materials and the effects of radiation on the properties of the structural metals and other materials, and such matters as strength and creep of uranium alloys. The treatment throughout is exhaustive. Clearly this is a reliable working library for all engineers, scientists and administrators concerned with the origination and operation of nuclear plants of all kinds.

Thermodynamics.—By Gordon J. Van Wylen. New York, 1959; John Wiley & Sons Inc., London; Chapman & Hall Limited. 64/– net (by post 65/9). 567 pp. $5\frac{3}{4} \times$ 9in.

There has been a steady flow of textbooks on thermodynamics lately, and most of them have been quite good, particularly in the way in which the authors present a not too easy subject to the student. The present book certainly has merit in this respect. Many men find that they can understand thermodynamics better when they return to it after some practical engineering experience. We rather suspect that youngsters today do not always experience this so acutely. They come to it with an already awakened practical awareness arising out of the opportunities of everyday life (with motor vehicles, power models and the like) and the new authors lead them on from that. Mr. Wylen, for instance, starts his readers off on the simple steam power plant, the refrigerator, the gas turbine and the liquid-propellant rocket, at once catching the attention and satisfying the need to be up to date. He then puts the reader to work, getting the definitions settled first before going on to the properties of a pure substance, the notions of work and heat, the laws of thermodynamics, entropy, ideal gases and their mixtures, reciprocating machines, refrigeration, flow through nozzles and blades, equations of state, generalized charts, combustion and equilibrium. Appendices deal with the control volume (an alternative view of the ideas of open and closed systems), tables of thermodynamic properties, selected references and answers to selected problems in the text.

World Economic Survey.—The United Nations World Economic Survey (H.M. Stationery Office, 22/6 net) for 1958 shows that early in 1959, business activity in industrial countries was continuing to recover from the recession. By March of this year the index of industrial production was slightly higher than the pre-recession peak and it was expected that production for the whole of the current year would be above the 1958 level. According to the survey the prices of a number of primary products began to show signs of recovery in the second half of 1958, but no great or rapid increase is expected. The fact that there had nevertheless been no general decline in economic activity in Western Europe on a scale comparable with that in the United States up to the end of 1958 was due mainly to the greater stability of total demand. Confidence did not weaken to the same extent as in North America, and inventory liquidation was much more limited, affecting only a few specific sectors. Particularly important in sustaining the level of final demand in Western Europe was the continued rapid growth in consumption of durable goods in the main producing countries.

Laboratory Manual.—The British Cast Iron Research Association, Alvechurch, Birmingham, has published Part I of a laboratory manual, "Selected Methods of Analysis of Foundry Materials". This first part deals with the sampling and analysis of pig and cast irons for carbon, silicon, manganese, sulphur, phosphorus, nickel, chromium, molybdenum, copper, titanium and van-



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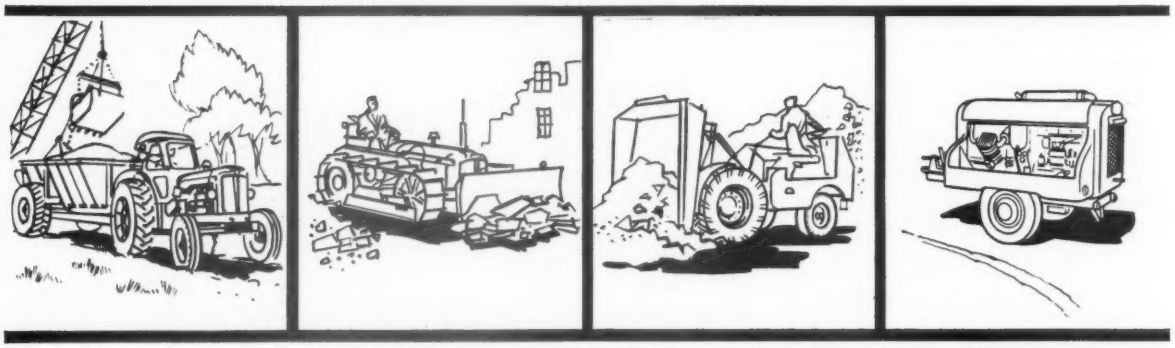
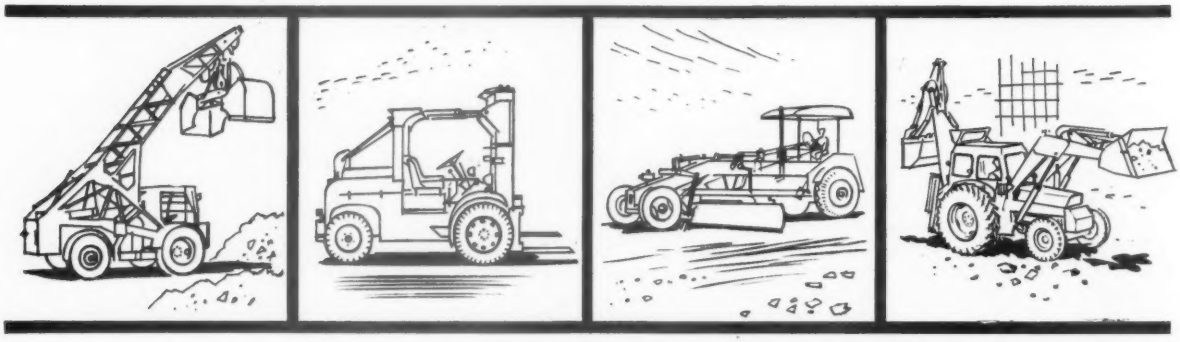


They look for Fordson Power because it gives equipment the stamp of reliability, ensures high output at low cost, and because it has the backing of the Ford world-wide service and spares organisation. There are Fordson Industrial Units in the 30-40 and 40-50 b.h.p. classes, in more than 100 different assemblies. Fit Fordson and you get all the benefits of quality mass-production from Ford's famous Dagenham factory, the biggest producer of mobile power units. Fit Fordson, the unit tailor-made to your requirements. Send for detailed specifications today.



Wise buyers insist on **Fordson Power**

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adium. Sections are also included on spectrographic methods, laboratory equipment, apparatus and reagents and laboratory techniques. The treatment concerns the practical details of each method which makes the book particularly suitable for use at the bench.

Raising Productivity in Smaller Firms.—That there is considerable scope for raising productivity and lowering costs in smaller firms by the use of modern methods and techniques of management is amply demonstrated in a new booklet published by the British Productivity Council. Based largely on the work of The National Union of Manufacturers Advisory Service (NUMAS), it describes what has been done in twelve typical small firms through techniques such as work study, costing, production control, office organization and incentive schemes. The National Union of Manufacturers was enabled to institute an Industrial Advisory Service in 1953/4 with the aid of Conditional Aid grants, and this is now established as a self-supporting, non-profit making organization. The report describes the development of NUMAS and examines some aspects of the problems confronting the smaller manufacturing firms which constitute its main field of activity. Now that the Conditional Aid Scheme has been wound up the British Productivity Council has undertaken to follow up some of the activities it promoted which have been established on a continuing basis. One method of follow up has been the preparation of reports placing special emphasis on case examples, and this publication is the latest one in that series.

The case histories are from firms ranging in size from 6 to 300 employees and from a wide range of industry including commercial vehicle body building, manufacture of electrical components, narrow tapes and fabrics, lithographic printing, plastics, measuring implements, office and school equipment, and horticulture. An introductory article describes what an Advisory Service can do for smaller firms and indicates the way in which NUMAS operates.

Copies are available from the British Productivity Council, 21 Tothill Street, SW1, price 2/6d.

Petroleum Centenary.—August 27 saw the 100th anniversary of the foundation of the modern international oil industry, and in recognition of the occasion the Petroleum Information Bureau has published a pamphlet outlining the history of the oil industry during the past century. Copies are freely available to readers of MECHANICAL WORLD on application to the Bureau at 29 New Bond Street, London, W1.

Engineering Research.—A bulletin of 114 pages has been issued regularly by the University of Illinois, Urbana, Illinois, U.S.A., summarizing engineering research at the university's experimental station during 1957–58. The subjects cover every branch of engineering and each is presented as a separate item in a brief note together with references to more full forms of publication. Photographic illustrations accompany some of the items.

Diesels with Automatic Controls.—Earlier this year Mr. K. L. Ives presented a paper to the Diesel Engine Users Association entitled "The Application of Diesel Engines to Automatically Controlled Power Plant". The paper has now been reprinted, complete with discussion and is available from the association's offices at 18 London Street, London, EC3, price 15/–. The various forms of automatically controlled diesel driven plant are described with particular reference to the possible effects of specialized control features on engine design.

Chemical Engineers Regulations.—Now available from the Institution of Chemical Engineers, 16 Belgrave Square, London SW1, is a revised edition of the regulations for the admission of student, graduate and corporate members, and for the examinations of the institution. The booklet also gives particulars of the institution's publications, awards and library.

Netherlands Directory.—An annual publication: "Buvoha Trade Letter", 1959, contains a great number of addresses of industrial and commercial firms in the Netherlands, interested in trade relations with firms abroad. Anyone interested in business relations with Dutch firms can get a free copy from Bureau Voor Handelsinlichtingen (The Commercial Intelligence Office), Amsterdam-C., Oudebrugsteeg 16.

Electrical Research.—The Research Division of The Hydro-electric Power Commission of Ontario publishes a quarterly journal called "Ontario Hydro Research News". The current number deals entirely with problems relating to power transmission at extra-high voltage arising out of work in recent years by the division in preparation for the construction of a transmission line. This, while it may possibly be operated at 230 kV to start with, will be required to operate at extra-high voltage at some time during the next ten years.

New Standards

Periodicals of reference value: form and presentation (B.S. 2509: 1959). Price 6/– net.

Intended for those who edit or contribute to scientific, technical and other periodicals used for reference over a long period this new publication brings up to date the previous standard, published in 1954 under the title "Layout of periodicals". The new title has been substituted since "Layout" was considered to have too strong a typographical implication to describe the content of this standard, but all the clauses of the 1954 edition have been retained with modifications incorporated in the light of comment and criticism over the past five years. The most significant change is in the clauses on "Articles and other contributions" which now advocate internationally recommended practice; the new standard itself conforms in the main to a recommendation of the International Organization for Standardization (ISO/R8).

Steel sheets for magnetic circuits of power electrical apparatus. Part 1: 1959—Non-orientated steel. (B.S. 601: 1959). Price 6/–.

This revised standard reflects advances since the first edition was issued 24 years ago. It will be followed by Part 2, for orientated steel. Part 1 deals with non-orientated magnetic steel sheets and strip intended primarily for machines and transformers operating at power frequencies. It applies to material normally supplied in the fully processed condition—unless specifically ordered by the purchaser to be supplied in another form. Four appendices deal respectively with the method of testing total losses and total excitation; magnetization measured by d.c. reversals; typical values for stacking factor; typical values for effect of ageing; and the bend test for brittleness. At the option of the purchaser, the fully processed material may be processed on one side only or on both.

British Standards Institution, 2 Park Street, London, W1.

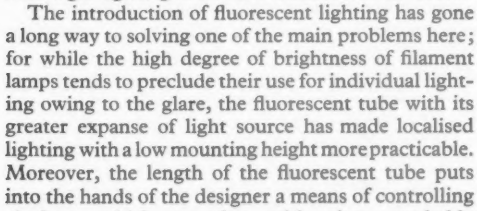
Lighting-2

The general principles of factory lighting have been dealt with in the previous data sheet (No. 6). This one considers briefly certain factors—not always fully appreciated — that influence the lighting for some particular factory applications. The next data sheet will carry the subject further.

Work benches

The most universal application of lighting is to bench work, for there is no branch of manufacturing that does not have its work benches which, of necessity, are used for a great variety of occupations. No single lighting method is suitable for all cases.

The introduction of fluorescent lighting has gone a long way to solving one of the main problems here; for while the high degree of brightness of filament lamps tends to preclude their use for individual lighting owing to the glare, the fluorescent tube with its greater expanse of light source has made localised lighting with a low mounting height more practicable. Moreover, the length of the fluorescent tube puts into the hands of the designer a means of controlling shadows which, together with glare, probably represent the most prolific causes of errors and eye-strain.



With narrow individual benches (not more than 4 ft. wide), there are four basic methods of localised lighting: longitudinal, transverse, diagonal or a combination of longitudinal and transverse. With wider benches it is not advisable to use fittings directly over benches, and fittings should be behind the workers at each edge of the bench. Where particularly high illumination is required, fluorescent fittings may be mounted as local lights—low enough for the skirt of the reflector to conceal the lamps from the eye of the operator.

It is good practice to use reflectors which allow a reasonable amount of light to spill upwards, giving a certain amount of general lighting.

High-bay shops

Probably the most difficult of all factory lighting problems is that of high-bay lighting. In lofty, long and sometimes necessarily dirty shops such as those which house really large machine tools and overhead cranes, which do their worst to defy the efforts of the illuminating engineer, it requires great ingenuity, coupled frequently with high lamp wattage, to provide the workman with enough light to allow him to do his job efficiently. From the planer operator to the slinger, the workman, though he may not know it, is dependent on good lighting if he is to avoid an over-cut or a serious crane mishap.

The major problems associated with the lighting of high and relatively narrow shops, such as heavy machine shops and foundries, are :—

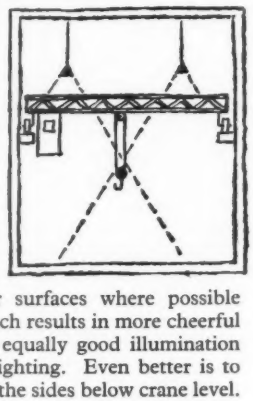
(a) Poor light utilisation caused by excessive light absorption by the large and often dark wall area.

(b) Preponderance of light flux downwards and poor cross lighting causing poor illumination on vertical surfaces, and heavy shadows.

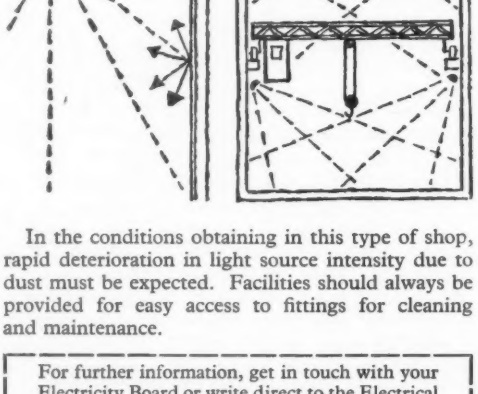
(c) Possibility of heavy light absorption in the atmosphere.

(d) Difficulty of access to high fittings for maintenance.

In high-bay workshops there is a tendency to use concentrating fittings so that the maximum proportion of the light output reaches the working area without spread to the walls, but the saving in wall absorption is obtained only by accepting a depressing environment, poor cross lighting and heavy shadows.



In many cases it is good practice to accept the inevitable reduction in light utilisation by wall absorption and to reduce this by applying light colours to interior surfaces where possible throughout. This approach results in more cheerful conditions and provides equally good illumination values and better cross lighting. Even better is to add angled lighting from the sides below crane level.



In the conditions obtaining in this type of shop, rapid deterioration in light source intensity due to dust must be expected. Facilities should always be provided for easy access to fittings for cleaning and maintenance.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2. Telephone : TEMple Bar 9434.

Excellent reference books on electricity and productivity (8/6 each, or 9/- post free) are available—"Lighting in Industry" is an example.

E.D.A. also have available on free loan in the United Kingdom a series of films on the industrial uses of electricity, including one on industrial lighting. Ask for a catalogue.

7931

BUSINESS & PROFESSIONAL

Personal

GRIFFIN & GEORGE, laboratory furnishers, announce the following staff appointments: **Mr. Edward Bentley** becomes London branch manager. **Mr. Kenneth Freer** succeeds Mr. Bentley as manager at Manchester, where **Mr. James Branson** becomes assistant branch manager. **Mr. R. H. Powell** has relinquished his appointments with the Griffin & George group of companies.

Mr. W. G. Hendrey, M.I.E.E., who has been a director of British Insulated Callender's Cables Limited since 1938, has retired. He joined the former Callender's Cable and Construction Company Limited in 1903. **Mr. William Fraser, B.Sc.,** has been appointed a director of the company.

Mr. W. J. Lloyd has been appointed South Wales area manager of Bowmaker (Plant) Limited based at the Cardiff depot. **Mr. Dennis M. Beddows** has been appointed sales promotion manager. **Mr. F. J. Butler** has now completed his duties with the Bowmaker Training Scheme and becomes used equipment manager, co-ordinating the buying and selling of used and second-hand equipment. Mr. Butler will be operating from Willenhall depot. **Mr. Jack Cooper** has relinquished his territory in the West Country and has taken over the South West Area comprising Devon, Cornwall, Somerset, Dorset, and parts of Hampshire and Wiltshire.

METROPOLITAN - VICKERS ELECTRICAL Co. Limited, announces that **Mr. H. Brown, M.I.T.A.,** has been appointed traffic manager and that **Mr. E. J. Scotcher, B.Sc. Tech., A.M.I.E.E.,** has been appointed factory superintendent at their Huyton works.

Dr. A. G. J. Buckle, M.Sc., Ph.D., A.R.I.C., has been appointed technical director of Technicon Instruments Company Limited. Prior to this he was chief chemist of the Helsby Division of British Insulated Callender's Cables Limited. After establishing a full laboratory service in London for Technicon Instruments Company Limited he will be holding a series of training courses for users of the Technicon Auto-Analyser, which is an important feature of this company's technical services.

NASH AND THOMPSON LIMITED, Chessington, Surrey, announce the reorganisation of their sales division. **Mr. J. L. Foreman** has recently been appointed sales manager. **Mr. D. E. Morris** has been promoted to sales office manager with special responsibility for process control, oil, gas, mining, medical and survey equipment. **Mr. R. C. Blezard** is the sales engineer responsible for all metallurgical sales and **Mr. T. N. Mordue** covers the counties south of the Thames for the Nashton range of miniature electronic test equipment. The sale of scintillators is now covered by **Mr. D. A. Ginger,** the chief chemist, and environmental testing by **Mr. G. F. Thompson,** head of the component testing laboratory.

Mr. M. Robinson, who has been associated with Lancashire Dynamo since 1946, has been appointed manager of the group's Bristol area office in succession to **Mr. E. N. Evans, M.I.E.E., M.Amer.I.E.E.**

Air Commodore N. A. Tait, O.B.E., M.I.Mech.E., M.Inst.T., A.F.R.Ae.S., has joined the sales staff of Simmonds Aerocessories Limited, a member of the Firth Cleveland Group, following his retirement from the Royal Air Force.

Mr. Orlando Oldham has been appointed assistant managing director of Oldham and Son Limited. Mr. Orlando represents the fourth generation of the Oldham family in the management of the business—which was founded by his great-grandfather, Joseph Oldham, in 1865. **Mr. J. Dowse** has been appointed production director and **Dr. C. D. J. Statham** has been appointed to the board in the capacity of sales director.

AMAR TOOL AND GAUGE COMPANY LIMITED, Grove Road, Chadwell Heath, Essex, has appointed **Mr. E. G. McLeod** as sales representative for the West Country and South Wales.

Mr. K. Fearnside has been appointed to the board of Smith's Aircraft Instruments Limited as director of research. Formerly research manager at the company's Cheltenham factory, Mr. Fearnside will continue to have charge of research activities in his new appointment.

Mr. Maurice Tattersfield, A.C.A., has been elected to the board of The George Cohen 600 Group Limited following his appointment as financial controller of the group last year. **Mr. J. A. Dewhirst** has been appointed managing director of Midgley and Sutcliffe Limited, the 600 Group company which manufactures the "Richmond" range of radial drills and milling machines at its works at Hunslet, Leeds.

FOUR new appointments are announced by A.E.I. Heavy Plant Division: **Mr. E. C. Barwick, B.Sc.(Eng.), M.I.E.E.,** manager, Large Electrical Machine Engineering (Rugby). **Mr. E. E. A. Grace, B.Sc.(Eng.), A.M.I.E.E.,** manager, Medium Electrical Machine Sales. **Mr. K. F. Raby, M.A. (Cantab.), A.M.I.E.E.,** manager, Medium Electrical Machine Engineering. **Mr. W. H. Hunt,** superintendent, Medium Electrical Machines Department.

AFTER 45 years' service with the British Thomson-Houston Company **Mr. W. J. Pool, B.Sc., A.M.I.E.E.,** has retired. From 1941 to the end of 1956 he was manager of the industrial engineering department but relinquished this position in order to study problems associated with nuclear power projects on which the company was engaged.

Mr. James L. Ritchie, B.Sc.(Eng.), has been appointed sales director by Holman Brothers Limited, Camborne, Cornwall, with responsibility for the direction of the Holman Group's sales organisation at the Camborne headquarters and in the United Kingdom and overseas. He has become an associate director of Holman Brothers and is based at Camborne.

EDGAR ALLEN & CO. LIMITED announce the appointment as publicity manager, of **Mr. Alan B. Jordan** in place of **Mr. Eric N. Simons.** The services of Mr. Simons will be retained by the company as a publicity consultant, and as editor of the "Edgar Allen News", which post he has occupied since the inception of the journal.

Obituary

WE regret to record the death of **Mr. E. J. Jordan,** former district engineer with British Insulated Callender's Construction Company Limited, at Barking.
Mr. Jordan joined Callender's Cable and Construction Company Limited in 1919 and retired in 1956 at the age of 65, after 36 years' service.

Addresses

THE name of Cambrian Wagon and Engineering Company Limited has been changed to incorporate the name of the parent group of Powell Duffryn Limited. The name "Cambrian" will be retained both as a trade name and in the address of the company, which will now be Powell Duffryn Engineering Company Limited, Cambrian Works, Maindy, Cardiff. Tel.: Cardiff 29611.

INTERLAS LIMITED, a new company with registered office at 232 Bromham Road, Bedford, has been formed to import and distribute welding plant and accessories throughout the United Kingdom, and is a joint enterprise of the continental welding supplies firm of Interlas N.V., of Soesterberg, Holland, and Mr. Eric Courtney, well known for his past connexions with British welding positioner firms, and now managing director of the new organization.

THE Standard Building Department of Sanders & Forster Limited is being transferred from the head office at Barking to new premises adjoining the branch works at Warton Road, London E15 (Tel.: Maryland 3228).

TORVAC LIMITED, Histon, Cambridgeshire, has been formed to design and manufacture all types of vacuum equipment.

THE CVA GROUP have opened executive offices at 79 Davies Street, London W1. Telephone: Mayfair 3051/2.

THE Newcastle office of the Lancashire Dynamo Group has been moved to new premises. The new address is as follows: Lancashire Dynamo Group Sales Limited, Eagle Star House, 32-34 Mosley Street, Newcastle upon Tyne 1. The telephone numbers remain unchanged: Newcastle 28621/29736.

A NEW company, George Cohen (Dublin) Limited, has been formed to undertake general machinery trading in Eire. The address is Georges Place, Blackrock, Dublin, and the general manager is Mr. E. P. Purcell, A.M.I.C.E.

A NEW subsidiary company has been formed by Holman Brothers Limited, Camborne, Cornwall, in conjunction with their Spanish distributors, Maclaurin, Morrison y Cia. (S.A.), and their Spanish associates. The title of the new company is Holman Iberica S.A. and Holman pneumatic products are already under way at Pinto, near Madrid, where the first portable compressor unit has now been produced.

Business Developments

Trading Agreements

INSPECTION SERVICES LIMITED and R. F. Fraser-Smith, late of 69 King's Cross Road, London WC1, have merged interests and enquiries and orders for non-destructive testing equipment, including radioactive isotope containers, etc., should be addressed to: Inspection Services Limited, Oldfield's Trading Estate, Sutton By-Pass, Sutton, Surrey.

AN agreement has been signed between the Societé Nouvelle des Huiles Minerales of France, and Rocol Limited, Swillington, near Leeds, for the manufacture of Rocol molybdenised and other specialised industrial and motoring lubricants in France and for their distribution throughout the European Common Market area.

NASH & THOMPSON LIMITED, Chessington, Surrey, have concluded arrangements for the marketing of the G.K.N. Micro-Hardness Tester, manufactured by Associated Automation Limited, Dudden Hill Lane, London NW10.

EDGAR ALLEN & CO. LIMITED of Sheffield having been granted the sole licence for the manufacture and sale in this country of Bamag resonance screens are to extend the scope of their engineering division.

G. & J. WEIR LIMITED, Glasgow, and Chicago Bridge and Iron Company of Chicago, Ill., are setting up a jointly owned subsidiary company in the United States to be known as Weir-Chicago Bridge Inc., thus combining the knowledge and experience of G. & J. Weir Limited, the world leader in the manufacture of large sea water evaporation and distillation plants, with the fabrication and construction facilities of Chicago Bridge.

A reciprocal trading arrangement has been made between Amber Chemical Industries Limited (11a Albemarle Street, London, SW1) and the D. A. Stuart Oil Company Limited of Chicago and Detroit (in association with Canadian D. A. Stuart), whereby Amber Chemical Industries Limited is appointed sole distributor and licensees in the U.K., Eire, South Africa, Australia and New Zealand for all the products of D. A. Stuart. The latter company is appointed sole distributor and licensee in the U.S.A., Canada and South America for the range of products of Amber Chemical Industries Limited.

BRITISH INDUSTRIAL GASES LIMITED of Enfield, have concluded an agreement with the Harris Calorific Company of Ohio, U.S.A., whereby the latest American designs in oxy-fuel gas cutting equipment will be manufactured in Great Britain, the agreement allowing B.I.G. to export the equipment to all countries except Canada, Australia and South Africa.

Company acquisitions

CRABTREE ELECTRICAL INDUSTRIES LIMITED has acquired for cash all the issued share capital in the private company of C. M. Churchouse Limited, Clarendon Cross, London, W11, manufacturers of electric light fittings, and its wholly owned subsidiary company Robbins & Bradley Limited of Birmingham.

G. & J. WEIR HOLDINGS LIMITED acquired the whole issued share capital of Lobnitz & Co. Limited, the long-established Renfrew dredging and engineering undertaking whose premises are adjacent to the works and shipyard of Wm. Simons & Co. Limited, another member of the Weir group.

Agents and Distributors

SYKES MACHINE TOOL CO. LIMITED, Hythe Works, The Hythe, Staines, Middlesex, have been granted the agency for Great Britain by Maschinenfabrik Ravensburg Ag., 14b Ravensburg, Württemberg, Germany. The Ravensburg range includes facing, boring and surfacing lathes, slotting machines and various special-purpose lathes.

MARTONAIR LIMITED, manufacturers of pneumatic equipment have announced the appointment of Ernest Lowe & Co. (Pty.) Limited, Cr. 5th Ave. and 5th St., Booysens Reserve, Johannesburg, as agents for the Central African Federation and the Union of South Africa (except Port Elizabeth area).

Contracts and Work in Progress

GRESHAM TRANSFORMER GROUP. Further order value approximately £30,000 for the supply of a number of power transformers to public service authorities in New Zealand.

THE ENGLISH ELECTRIC COMPANY LIMITED, Stafford.—One million pounds switchgear order from the C.E.G.B. for a new switching station at Stalybridge, Cheshire.

Order from N.C.B. for a 1,750 hp mine winder for Newstead Colliery, East Midlands Division. Robey & Co. Limited of Lincoln are the sub-contractors for mechanical equipment.

48 Transformers and main a.c. distribution switchboard for the new 45,000 ton P. & O. liner *Canberra* now being built by Harland & Wolff Limited, Belfast.

EKCO ELECTRONICS LIMITED.—£17,000 worth of nucleonic equipment for China ordered during July.

BROOKHIRST IGRANIC LIMITED (METAL Industries Group).—Automatic control equipment to the value of £8,500 for mechanical presses for the new Volkswagen factory near Melbourne, Australia. Twelve of the presses the order for which was secured by Clearing Division of U.S. Industries Inc., will be manufactured in England by Vickers-Armstrongs (Engineers) Limited.

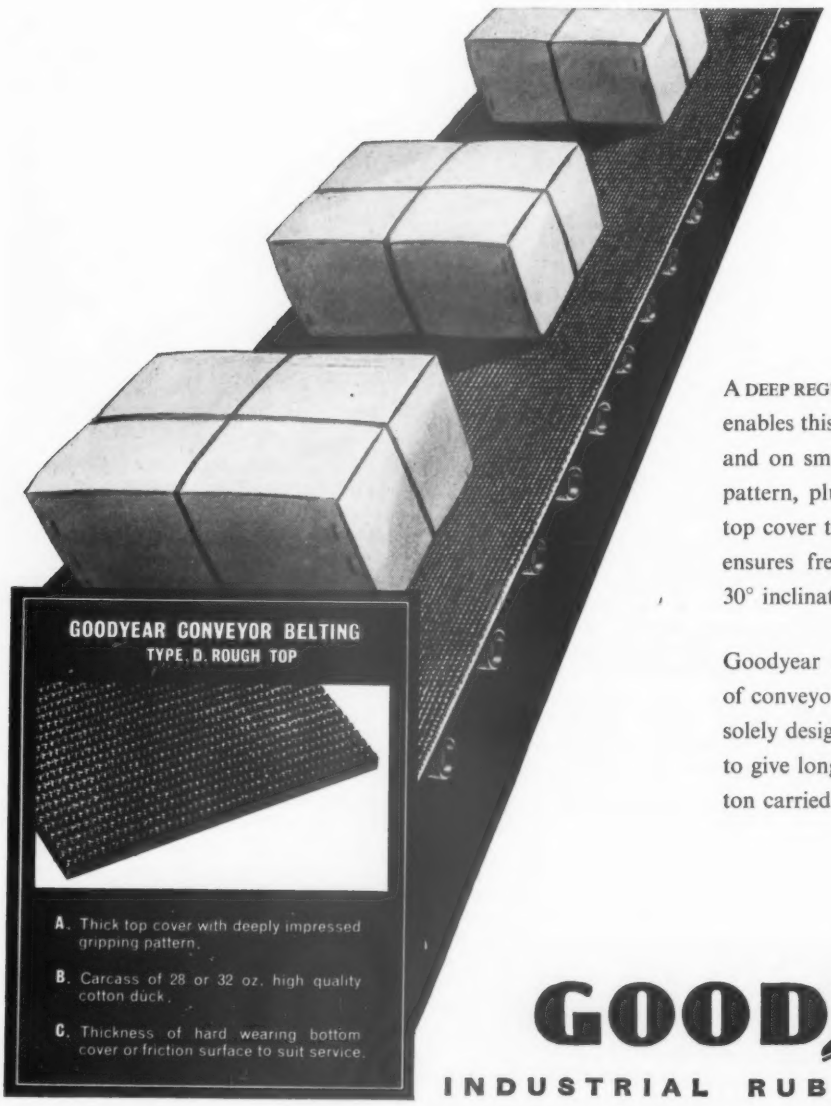
BRITISH RAILWAYS (SCOTTISH REGION).—Contracts placed include: John Boyd & Co., Annan: two 400-ft long electrically driven wood slat conveyors for Sighthill new goods station, Glasgow; The Motherwell Bridge and Engineering Company Limited: four 40,000 gal oil storage tanks for Haymarket motive power depot, Edinburgh; Lansing Bagnall Limited, Basingstoke: two fork-lift trucks for Dundee Tay Bridge goods station; The Siemens & General Electric Railway Signal Company Limited, Wembley: provision of automatic warning control, Airdrie to Kelvinhaugh.

FAWCETT PRESTON & COMPANY. (M.I. Group).—Overseas orders totalling about £140,000 including pulp-steeping presses for Courtaulds rayon plant now being built for Russia for which pumping equipment will be supplied by Towler Brothers (Patents) Limited of Rodley, extrusion machinery for Pirelli of Naples, Nordiske Kabel Fabrieken of Copenhagen, and the Holland Insulated Wire & Cable Company of Amsterdam.

Orders valued at almost £30,000 for cablemaking machinery for Finland and Denmark.

LIFT WITHOUT SLIP

with Goodyear rough top conveyor belting



A DEEP REGULAR pattern, exclusive to Goodyear, enables this belting to take a firm grip on sacks and on smooth articles, such as cartons. The pattern, plus a choice between soft and hard top cover to suit the needs of the installation, ensures freedom from slip on slopes up to 30° inclination.

Goodyear Rough Top belting, like all styles of conveyor belting in the Goodyear range, is solely designed for a specific type of duty, and to give long, reliable service at lowest cost per ton carried.

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS

CONVEYOR BELTING • TRANSMISSION BELTING • HOSE • V-BELTS

E.M.I. Electronics Limited.—Orders for Emidec computers received from H.M. Stationery Office for R.A.O.C., Kodak Limited, British European Airways, Barclays Bank Limited, Air Ministry, and Ministry of Labour and National Service.

Leyland Motors Limited and Metropolitan-Cammell-Weymann Limited have secured £1¼m. contract from Cuba for 200 diesel buses.

Thomas Robinson & Son Limited, Rochdale.—Order from Republic Flour Mills Incorporated, the Manila company for which Robinsons established the first flour mill in the Phillipines.

Westinghouse Brake and Signal Company Limited.—60,000 amp water cooled selenium rectifier order for Japan secured through Electro-Chemical Engineering Company Limited.

Perkins Engines Limited.—Substantial order for their Four 270D engine from the largest manufacturer of combine harvesters in Western Europe, Geb. Claas, Maschienenfabrik G. m. b. H., of Harsewinkel, Western Germany.

Electric Resistance Furnace Company Limited.—Further orders from Caterpillar Tractor Company Limited for furnaces valued nearly £50,000.

A.E.I. Heavy Plant Division, Rugby.—Diesel-electric propulsion machinery for new G.P.O. cable ship to be built by Fairfield Shipbuilding and Engineering Company.

British Thomson-Houston Export Company Limited. (A.E.I.).—Order for the Federal Electricity Commission of Mexico to construct and equip steam power station.

Cable and Wireless Limited.—£2m. Commonwealth cable order for the first section of the commonwealth round the world telephone cable to be laid between Scotland and Newfoundland in 1961. The cable will be made at the Greenwich factory of Submarine Cables Limited, London.

Blaw Knox Chemical Engineering Company Limited.—Contract for new synthetic chemical compounds plant for Petrolite Limited, Kirkby Industrial Estate near Liverpool.

Taylor Woodrow (Nigeria) Limited.—Contract for a one mile long road bridge across the Niger to link the Eastern and Western regions of Nigeria at a cost of £5¼m. received from the Federal Government of Nigeria, Lagos. Further contract for £¼m. for 47 miles of road works under the development plan of the Western Regional Government, Nigeria.

Shipbreaking History

The Hughes Bolckow Shipbreaking Company of Blyth, Northumberland, celebrates its 50th anniversary in 1961. A short history of the company is being prepared and the author, Mr. Horace White, Group Public Relations Officer of Metal Industries Limited, Brook House, Park Lane, London W1, would welcome any information about its early activities. Photographs and documents will be carefully looked after.

Trade Literature

Semiconductors

An introduction to the principles, materials and uses of semiconductors is provided by a technical publication issued by Johnson, Matthey & Co. Limited, 73–83 Hatton Garden, London, EC1. The various kinds of diodes and transistors are described and some thermo-electric devices. A series of data sheets gives properties of germanium, pure metals and alloys for semiconductor devices, and of salts and anodes for the manufacture of semiconductor devices.

Rentweld Arc Welder

After 15 years of only minor modifications to their most popular model of arc welder, Rentweld Limited have now ready a simplified model of their 180 amp set with a single current regulator handle. The set has 10-amp steps in the 30–120 amp range, is oil immersed and sells at £35. It is fully described in a folder obtainable from Rentweld Limited, 94 Camden Road, London, NW1.

Flexible Furnaces

Electrothermal heaters are a particularly convenient means of applying furnace heat where the use of an actual furnace would be inconvenient or impossible. For instance, electrothermal armoured heaters in the form of specially prepared resistance wire can be wound round a weld, the whole logged and electric current supplied from welding generator transformer, or from a mains supply transformer. Where higher operating temperatures and wattage densities are required, the "flexible furnace" offers unusual advantages, whether for vessel and plant heating, heat treatment, pipe heating, or for making portable furnaces. The flexible furnace is in sheet form and is built up of specially shaped ceramic beads threaded on resistance wire. New leaflets giving technical details, illustrations and prices of both types of appliance are now available from the makers, Electrothermal Engineering Limited, 270 Neville Road, London, E7.

Giant Guillotines

The "Giant" is the first of an extensive new range of guillotines to emerge from the production line at the Waterloo Engineering Works of Furnival & Co. Limited, Stockport, Cheshire. Primarily intended for paper mills, paper converters and large printing firms, the "Giant" will also make short work of such diverse materials as cellophane, metal foil, plastics, linoleums and hardboard. The standard machine is made in two sizes to give 75 in. and 85 in. cuts. "Super Giants" for larger cuts are made specially. An illustrated catalogue giving full particulars is now available from the makers.

Mining and Engineering Wire Ropes

A new catalogue of mining and engineering wire ropes is now available from The Tyne Wire Rope Manufacturing Company Limited, Albert Terrace, South Shields, Co. Durham. It is wire bound and of a handy size for either desk or pocket. Particulars of the construction and strength of a wide range of rope are given with illustrations, and there are informative sections on such matters as how to fit and splice wire ropes as well as data on selecting ropes for particular purposes—slings, lifts—etc.—and a quantity of other information of use to the rope user.

Pneumatic Equipment

A new catalogue of pneumatic equipment in bound loose-leaf form with thumb index, comes from Air Automation, 26 Sharrocks Street, Wolverhampton, Staffs. The range includes both diaphragm/poppet and piston valves, cleaners and lubricators, hose, tubing and blow guns, air line fittings, cylinders, vices, and core box vents. Overall dimensions and connection sizes of the various components are tabulated in full.

Industrial Ventilation

A folder from Greenwood's and Airvac Limited, Beacon House, Kingsway, London, WC2, illustrates both powered and natural ventilators for factory buildings. There are types for flat roofs, roof ridges and for roof slopes and also a continuous rooflight type. A wall fitting, movable or fixed, gives maximum unrestricted free area with complete weathering.

Heating Tapes and Jacketing

A variety of heating tapes and appliances are described in a catalogue and leaflets issued by The Stabilag Company Limited, Mark Road, Hemel Hempstead, Herts. The electrical heating tapes are readily applicable to the heating of gas and oil pipe lines, the stress relieving of welds, the curing of resin-bounded pipe joints, etc. Other industrial purposes are served by rod heaters, melting pots, heating pans, drum heaters, and there is also a range of mantles for heating laboratory flasks and the like.

Hollerith and Powers-Samas — I.C.T.

The amalgamation of the Hollerith and Powers-Samas concerns into International Computers and Tabulators Limited has

RAWLBOLTS

for SPEED

STRENGTH

SECURITY

SAVE TIME with Rawlbolts. Grouted ragbolts will take 3 days to harden before the machine can be used. Use Rawlbolts and the machine can be in production in much less than 3 hours. It can be moved easily to a new position when necessary.

SAVE LABOUR with Rawlbolts. No laborious and time wasting cold chiselling with Rawlbolts. The holes are drilled with a Rawltool to the exact size, the Rawlbolts dropped in and after the machine has been positioned the bolts are tightened. The expansion of the segments locks the bolts in the holes.

Write now *for descriptive broadsheet of R 1480 which incorporates a half size Rawlbolt Reference Chart.*

RAWLPLUG

The world's largest manufacturers of fixing devices

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resulted in the replacement of the house journals of the first two by a new journal issued by the new company. The first number of "ICT", as the journal is called, is devoted to the histories of the two component parts of the business and a summary of the services now offered. The journal is published from the new company's head office at Gloucester House, 149 Park Lane, London, W1.

Care and Use of Crucibles

Users of crucibles will welcome a new technical folder entitled "Your Crucible". It offers a general guide to the foundryman for getting the best from his crucibles and maximum efficiency from crucible melting. It illustrates step-by-step the procedures for setting in lift-out, bale-out and tilting furnaces, and for lighting-up, charging, melting and pouring and cleaning out. The folder may be had from The Morgan Crucible Company Limited, Battersea Church Road, London, SW11. The company, who maintain a test foundry, provide crucible users with a complete technical service.

Resins for Foundry Patterns

"Araldite" epoxy resin has proved very successful in making patterns and core boxes. Duplicates can be made by easy casting techniques and patterns made in this way are more durable than wood, are more stable and give a better surface finish. They are also resistant to moisture which gives them some advantage over iron and aluminium. The procedure for making Araldite moulds and core boxes is described in Technical Notes 197 issued by CIBA (A.R.L.) Limited, Duxford, Cambridge.

Lighting for Inspection

Some examples of the types of equipment and services provided by P. W. Allen and Company, 253 Liverpool Road, London, N1, are given in a catalogue newly issued by the company. There are many useful devices for the workshop, laboratory and office, all designed to give light of the right intensity in the right place. There are illuminated magnifiers and equipment for inspecting the inner surfaces of tanks and vessels, and high-power remote viewing equipment and periscopes for use in danger areas.

Kerry 11 in. Swing Lathe

A new catalogue from Kerry's (Engineering) Company Limited describes the AG and GC 11 in. swing lathes. These machines are built to toolroom limits and have precision ground beds and slides, and can be supplied with either straight or gap beds. A considerable range of ancillary equipment is available which enables these machines to be put to the fullest use. In the AG series there are two models admitting 23 in. between centres and two admitting 40 in. In the GC series corresponding dimensions are 22 in. and 39 in.

Passenger Lifts

Marryat & Scott Limited, Wellington Works, Hounslow, Middlesex, have issued a new descriptive leaflet giving dimensions and illustrations of the various passenger lifts which they manufacture. The lifts range in duty from 900 lb to 3500 lb load and are of high speed (variable voltage), two speed and single speed types. There are five control systems available to suit the different kinds of traffic.

Morganite Carbon Vanes

A card from The Morgan Crucible Company Limited, Battersea Church Road, London, SW11, sets out in detail the properties of Morganite carbon vanes. These are made in materials ranging from graphite-carbon to metal graphite, with properties for widely different conditions and for applications in which other vane materials would be unsuitable. They are indispensable for dry running, are chemically inert and resistant to most chemicals.

Trade Literature

Xerographic Equipment

Two new leaflets from Rank—Xerox Limited, 31–41 Mortimer Street, London, W1, explain how their new process of Xerography serves Ruston & Hornsby Limited and British Railways. The former concern is saving £1800 a year by using hand-operated Xerax equipment in their printing department; the second has speeded up printing and duplicating at Derby and has cut costs by 50%. Ruston & Hornsby have cut the cost of making off-set litho plates from £2000 to £200 a year. The process makes it possible to take an original document (text or drawing) and make multiple copies of it on an ordinary off-set duplicator. The original is merely exposed to a Xerox plate and the image transferred to a "master" in three minutes at a cost of fourpence.

Fabric Type Dust Collectors

A new edition of publication No. 46 issued by Keith Blackman Limited, Mill Mead Road, London, N17, gives particulars of the series TF fabric type collectors which offer a compact, economical and adaptable range of equipment for the filtering of fine dust. Either mechanical or hand shaking gear can be provided. Fourteen sizes of filter are listed in capacities ranging from 2000 to 50,000 cu ft per min.

Processing Equipment for the Electrical Industries

Controlled Heat & Air Limited, Smethwick, specialize in the design and installation of all kinds of industrial heating plant operating below 1200°F, as within this range forced convection is used with the highest degree of efficiency. Examples of this kind of plant supplied to the electrical industry form the subject matter of a new catalogue which illustrates coreplate varnishing, lamination varnishing, transformer drying and spraying, continuous varnish impregnation, batch type varnish impregnation, paint drying, battery plate drying, electric bulb drying and bitumen coating.

Flowdeck Steel Bridge Decking

Two new bridges over the St. Lawrence River had Flowdeck steel decking used in their construction. This is a form of grating which is very light and which appears to be quite acceptable to vehicular traffic: it must offer considerable saving by reason of there being no road surface to maintain. It is made by Fisher & Ludlow Limited, Bordesley Works, Birmingham 12, who have a new descriptive leaflet available which is accompanied by technical notes and perspective drawings of constructional details.

How to use Araldite Resin

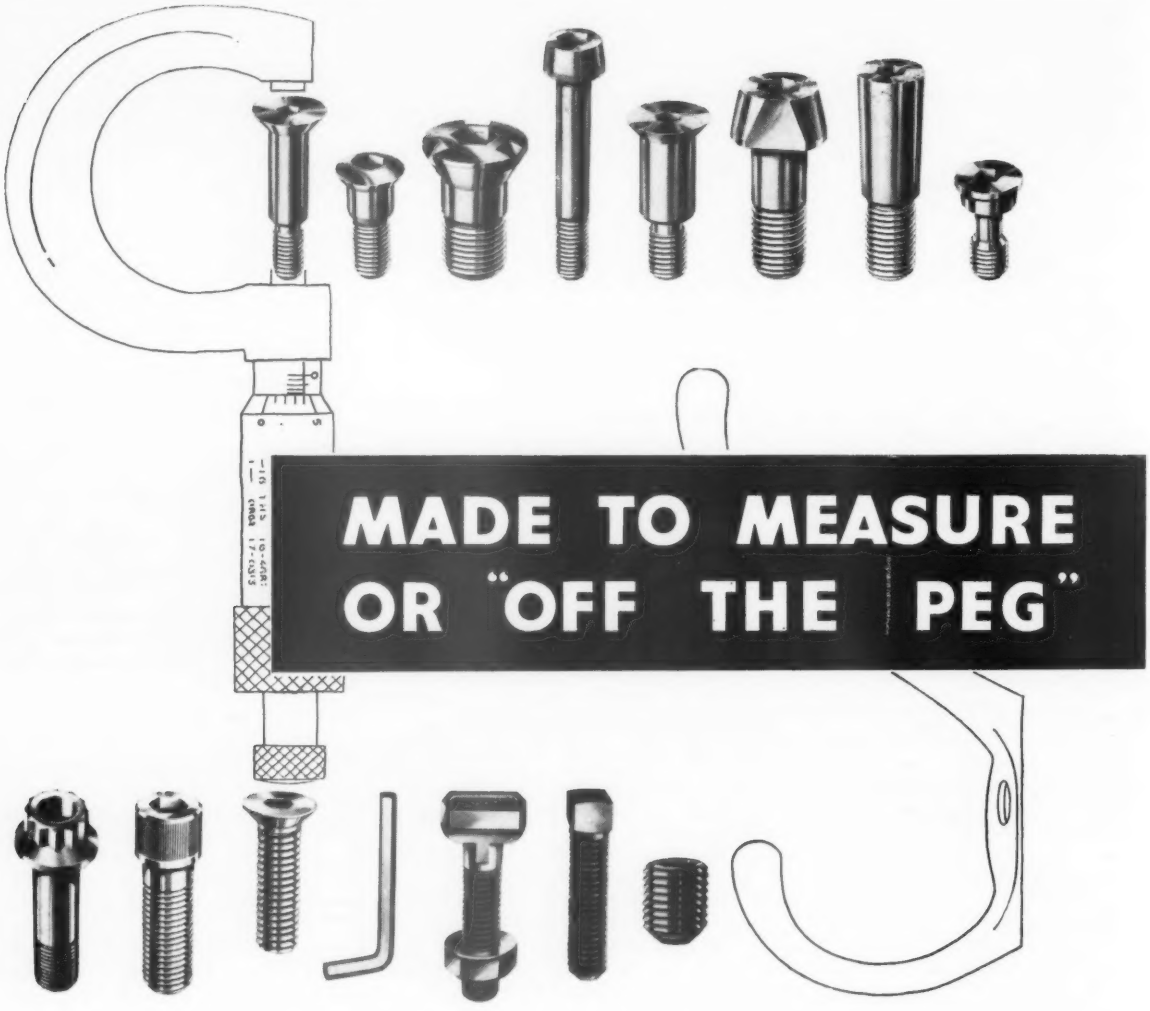
Araldite epoxy resins is much used in every sphere of engineering for joining metals and many other materials. They are syrupy liquids which when mixed with a catalytic hardener turn into hard transparent solids and with an adhesion to metal which may exceed 5000 psi. The joints resist heat to a substantial degree and are unaffected by moisture and chemicals. The makers of these resins, CIBA (A.R.L.) Limited, Duxford, Cambridge, have available a new publication in folding chart form which greatly facilitates the choice of the right resin for a particular purpose, and indicates also the proper pre-treatment in each case. Physical properties are also given.

Pipe and Cable Finder

The Fisher "Electronic Witch" is the subject of a leaflet available from Greenham Equipments Limited, Clayton Road, Ruislip Road, Greenford, Middlesex. The instrument is carried in the hand while the operator walks over the ground wearing a pair of headphones. Great depth of penetration and high tracing accuracy are claimed.

New Ellison Hydraulic Valve

The latest development in the range of Ellison hydraulic valves is the EC Mark II which is suitable for pressures up to 2 tons per square inch, or more in special cases. It is available in a wide range of sizes and can be arranged for five methods of operation. Features are standardized components, positive closing, easy adjustment, reversible seats, and a pleasing exterior which is easily cleaned. An illustrated folder can be obtained from the



MADE TO MEASURE OR "OFF THE PEG"

You can nearly always find a screw in the vast Unbrako range calculated to do just what you want better than any other screw.

But modern developments sometimes call for special screws not even standard to Unbrako.

When that happens our highly trained team of fastener-minded experts really get enthusiastic, responding to the challenge. They like to co-operate with you at the blueprint stage for preference, helping to design the perfect screw for the job, or they will simply make the screw to your specification, just about as well as a screw can be made.

So, standard or special, you can always safely specify Unbrako, the people who offer the most comprehensive specialised screw service in the world.

To be on the safe side, better get in touch with Unbrako over any fastener question. Remember what they say — Unbrako screws cost less than trouble.

There are two Unbrako lists you should have in your library, and a postcard or telephone call will bring them by return. They form a detailed and comprehensive guide to the whole Unbrako range, standard and non-standard, and no progressive firm should be without them.

Unbrako screws cost less than trouble

UNBRAKO

UNBRAKO SOCKET SCREW COMPANY LTD COVENTRY Telephone: Coventry 89471

makers, George Ellison Limited, Perry Barr, Birmingham, 22B.

Level Control Equipment

New data sheets describing the Elcontrol fluid level control quote new lower prices for certain control units and for all probe fittings. The reduction takes the form of a withdrawal or diminution of the 10% advance made at the end of 1957. The data sheets are available from Elcontrol Limited, Wilbury Way, Hitchin, Herts.

Gyrol Fluid Drive

An 8-page bulletin from American-Standard, Detroit 32, Michigan, U.S.A., explains pipeline control with the Gyrol fluid drive. The combination of squirrel cage induction motor, Gyrol unit and centrifugal pump make up a packaged pumping installation. The Gyrol consists of an impeller and a runner coupled by a fluid vortex, stepless speed adjustment being obtained by varying the volume of the fluid. The drive copes with variable drawoff, change in viscosity or specific gravity, seasonal demand and the like.

Used Equipment Bulletin

"Bowmart" is an 8-page used equipment bulletin issued by Bowmaker (Plant) Limited. Printed in two colours and measuring 10 × 8 in. it illustrates the various machines for sale and gives details of all the used equipment held at Willenhall, Cardiff, Exeter and Clay Cross depots.

Carlisle. British Transport Commission. The Ministry of Transport has approved a scheme for the establishment of a railway marshalling yard at Kingmoor, Carlisle.

Cumberland. The County Council has accepted the tender of H. Cartner and Son, Knowe Terrace, Carlisle, for the erection of a £30,000 highways depot at Dalston, near Carlisle.

Gateshead. Sigmund Pumps Limited. Factory additions on Team Valley trading estate. The contractors are Monk and Company Limited, 38 Albert Road, Middlesbrough; architects, G. H. Gray and Partner, 8 Portland Terrace, Newcastle upon Tyne.

Middlesbrough. Kerrys (Great Britain) Limited. Additional warehouse and showroom. The architects are Myles-White, Vallance and Westwick, White Hart Street, Mansfield, Notts.

Peterlee (Co. Durham). Tudor Food Products Limited, Sandyford Road, Newcastle upon Tyne. Peterlee Development Corporation are building a £250,000 factory for this firm. The contractors are Leslie and Company, Woodlands Road, Darlington. Plans by the Development Corporation's architect at Shotton Hall, Shotton.

Stanhope (Co. Durham). George Blair and Company Limited, engineers. A pattern and fettling shop is to be erected by North-Eastern Trading Estates Limited, Stockton-on-Tees.

Stockton-on-Tees. The Michelin Tyre Company, are to erect a tyre depot on the Portrack Lane Estate, Stockton.

F. Hills and Sons Limited, joinery manufacturers, North Road. Works extensions. Architects, P. R. Middleton and Partner, 111 Albert Road, Middlesbrough.

Washington (Co. Durham). Pawsons Washington Limited. Factory extensions. Plans prepared by G. J. Cash, 3 Ward Ends, Halifax.

West Hartlepool. Price Tailors Limited. Factory extensions. The contractors are G. Stephenson Limited, Chester Street, Bishop Auckland.

Whickham (Co. Durham). James and Company, engineers. Factory extensions at Pennyfine Road. Plans prepared by E. Arnold, 21 Jenifer Grove, Newcastle upon Tyne.

Belfast. Magee & Co. (Belfast) Limited. The Ministry of Commerce is to make extensions to their factory in Donegall Road.

Birmingham. Electromagnets Limited, 1 Bond Street, are to erect new premises at Hampton Street.

Bridgnorth. Star Aluminium Company Limited. The Stourbridge Road factory is to be extended.

Cardiff. Brittoll Radiators Limited. New factory in Newport Road.

Cheltenham. Taylor Young (Printers) Limited, 79 Clarence Street. Extensions to works in Chapel Street.

New Factories

Croydon. R. Crawford & Co. Limited, Thornton Heath. Factory extensions in Dart Road.

Eastbourne. Ceilocrete Corporation are negotiating with the Borough Council for a site at Brampton Road trading estate.

Ellesmere Port. Flexpipe Limited. New factory.

Exeter. Pook Bros. & Winch Limited. New factory on the Marsh Barton trading estate.

Fareham. F. H. Jung & Son Limited, Wallington Brewery. Plans approved for new factory off Turnpike Road.

Guildford. Transformers & Rectifiers Limited, are considering the building of a new factory at Woodbridge Meadows industrial estate.

Hainault. Glenville Cabinet Company Limited, 555 Commercial Road, London E. New factory and offices in Fowler Road.

Hereford. John E. Goodwin (Hereford) Limited. Factory extensions.

Hessle, Yorks. Johns-Manville Company Limited, 20 Albert Embankment, London SE11. New factory at Haltemprice.

Hull. Neilson & Kay Limited, Kay's Wharf, Wincolmlee, New factory.

Ipswich. Ferodo Limited, 67 St. Matthews Street. New premises in Princess Street.

Leamington Spa. Bryson Bros. Limited, have applied for permission for factory extensions.

London. Booth & Driver Limited, 16 Oakleigh Road North, London N20. A new factory is to be erected in Whetstone Close.

L. Neuberger Products Limited. New factory at Rookery Way. Architects, Fox & Guntrip, North End Road, London NW.

Loughborough. The Loughborough Glass Company Limited. New factory in Regent Street and Union Street.

Nottingham Manufacturing Company Limited, Wellington Street factory is to be extended.

Lurgan. J. H. Glendinning & Co. Limited. Factory extensions by the Ministry of Commerce.

Mansfield. Foister, Clay & Ward Limited. Extensions to the factory at Redcliffe Road.

Sherwood Industries Limited. The Southwell Road West factory is to be extended.

Penryn, Cornwall. Singleton Bros. Limited. Alverton, Penzance, to erect a new factory.

Plymouth. F.S. Manufacturing (West End) Limited, to erect a new factory at Ernsettle.

Reading. Eaglecars Manufacturing Company Limited, 23 St. Mary's Butts, to build a new factory at Manor Farm.

Rochdale. Manchester Proofing Company Limited, Wood Street, Dyeworks, Middleton. Extensions to the works in Drake Street.

Smethwick. Dartmouth Auto Castings Limited. Extensions to pattern shop at Dartmouth Road.

Southport. D. G. Todd & Co. Limited. The contract for extensions to the works in Tulketh Street has been let to T. P. Jackson, 1a Saunders Street, Southport.

Stratford-on-Avon. Stratford Auto Components Limited, Shottery, Warwickshire. A light engineering factory is to be built in Masons Road.

Stretford. Parkinson Gas Meters Limited, Victory Works, Talbot Road. Extensions to works.

Surbiton. Siebe, Gorman & Co. Limited. Extensions to be made to the factory at Davis Road.

Wakefield. Harrup Bros. (Sirdar Wools) Limited, are to extend their Bective Mills.

Warrington. Alliance Box Company Limited. Architects for the new factory at Longford are J. Mather & W. H. McAllister, 84 Bridge Street.

Wednesbury. Crown Metal (Wednesbury) Limited. Factory at Darlaston Road is to be extended.

The Wednesbury Plating Company Limited, to erect a new factory at Holyhead Road.

Wellingborough. The Wollaston Vulcanising Company Limited, 1 Thrift Street, to build new factory at London Road, Wollaston.

Wolverhampton. J. Hill & Sons (Ironfounders) Limited. New factory is to be erected in Shipton Street, Horsley Fields.

Dundee. Oswald Tillotson Limited, Burnley. To erect a 6000 sq. ft. factory at Kingsway West and Liff Road, Dundee, to handle heavy commercial vehicle maintenance, repairs and body-building, and spares and component sales.

Glasgow. Sir William Arrol & Co. Limited, 85 Dunn Street. Assembly shop for steel structures at 92–142 Rigby Street, Glasgow E1.

The Caledonian Steel Wool Company Limited, 31 Firhill Street. Single storey extension to factory at Shuna Place, Glasgow NW.

Bilslands Brothers Limited, 75 Hydepark Street. Five storey extension to their bakery premises at 87 Hydepark Street, Glasgow C3.

J. & A. Law Limited, 328 Pinkston Road. Modification of four buildings for use as brass foundry. Small ancillary buildings will be erected to be used as coke and sand stores, and washing and drying accommodation. An internal roadway will be renewed.

The South of Scotland Electricity Board has acquired the ground floor of an office block for meter testing, standardisation, etc., at Inverlair Avenue, Glasgow S4.

J. R. M'Kellar (Alloys) Limited. Extensions to garage at 398 Townmill Road, Glasgow E1, comprising offices and pattern stores.

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The University reserves the right to appoint a person other than one of the applicants or to make no appointment.

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REQUIRED—one second hand Ruston & Hornsby locomotive 88 D.S. diesel shunter, weight preferably 20 tons. Suitable for standard gauge track—4′ 8½″. Manufacturer's number, year of manufacture, and any other relevant information should be stated. Box No. LW23, "Mechanical World", 31 King Street West, Manchester 3.

Patents For Sale or License

THE proprietors of Patent No. 732327 for "Improvements in or relating to Valve Operating Mechanism", desire to secure commercial exploitation by license or otherwise in the United Kingdom. Replies to Haseltine Lake & Co., 28 Southampton Buildings, Chancery Lane, London WC2.

THE proprietors of Patent No. 746434 for "Improvements in or relating to Friction Brake Mechanism for Intermittently Driven Machines", desire to secure commercial exploitation by license or otherwise in the United Kingdom. Replies to Haseltine Lake & Co., 28 Southampton Buildings, Chancery Lane, London WC2.

INDEPENDENT and small machine tool manufacturers. Positioning Mechanism, guaranteed selective Micro Inch Region. 1959 Pat. No. 814,408 and Imp. No. 32788. Entitled "Step and Repeat Micro Inch Accuracy". "ZERO POINT" Imps. Guide drawings based on Patents available, genuine principals. Licenses only. N. Bonamini, 3 Argyle Street, Port Glasgow.

THE proprietor of British Patent No. 677114, entitled "Spray Boom Hinge" offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 603659, entitled "Power-Lift Attachment For Tractors", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

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